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THIRTY-SECOND ANNUAL CONVENTION OF THE MASTER CAR BUILDERS' ASSOCIATION.

The convention was called to order at Saratoga Springs, N. Y., at 10 a. m., June 15, by President S. A. Crone, and was opened by prayer by Bishop Newman. The address of welcome was by Mr. A. P. Knapp, President of the village of Saratoga. This was the sixth visit of the Association in convention at Saratoga, and the welcome of former occasions was pleasantly renewed.

The Hon. Ashley W. Cole, of the New York Board of Railroad Commissioners, presented an address, in which the work of the Association in advancing safety and celerity of railroad travel received exceedingly favorable comment. The numbers of employees killed and injured in coupling cars had been reduced materially in recent years, which was due to the progress in applying safety devices to the cars. The speaker gave statistics showing the State of New York to be well advanced in their application; 74 per cent. of the cars on the lines within the State already had automatic couplers, and 40 per cent. had air brakes. The great service of the railroads in the present war was commented upon, comparison being drawn between the conditions of military transportation of the civil war and the vastly improved service of the present, which was exceedingly favorable to the Association, whose work had contributed largely to the improved conditions.

Mr. J. H. McConnell, in his reply to Col. Cole, sketched the progress of car building during the life of the Association, commenting upon the increase in capacities of cars and the reducing ratio of dead to live weight, the progress being such as to cause wonder as to what was to be done in the future. The comparison was aided by statistics and figures, with which Mr. McConnell is always abundantly supplied.

The Presidential address by Mr. Crone contained a number of suggestions of important matters which he desired to have the convention consider. It seemed advantageous to change the time of opening the convention to Wednesday morning, with a view of saving time to the members by reducing the interval between the master car builders' and the master mechanics' conventions. He considered the present limits of the height of drawbars of cars entirely too narrow, and would like to see the law changed to cover wider limits, to make the maximum height at least 35½ inches. The Association should take action with regard to a standard test of couplers, as had already been done with wheels and axles, and the rules for loading lumber should be supplemented with others for loading stone and rails. Dummy couplings for air brake hose had often been the subject of discussion, and he would like to see the use of this device removed from the "recommended practice" of the Association. More attention should be given to the adjustment of air brake apparatus, and he hoped to see this subject considered seriously. Efforts to reduce the labor and expense of auditing bills for repairs of cars in interchange were commendable, and standard sizes for bill blanks were desirable. The discussion on present difficulties with regard to wrong repairs of cars, was anticipated, and the solution was to hold intermediate roads responsible for such repairs by the proper use of repair cards. The Association had accomplished a great deal, but "progress" was the word for the future, and in leaving the Presidency the speaker urged the necessity of renewed efforts to fulfill the promises embodied in the traditions of the Association.

Mr. Andrews was called upon and responded briefly and humorously. The minutes of the 1897 convention were approved as printed. The report of the Secretary showed a net increase of seven active members and eight new roads represented. The present membership was 457—263 active, 189 representative and 5 associate members; and the bills of the Association had all been paid up to date.

The report of the Treasurer, Mr. G. W. Demarest, showed a balance of cash on hand of $8,245.61. In view of the funds on hand the Executive Committee recommended that the dues for next year should be reduced to $4 per vote, which was carried by vote of the Association. Messrs. W. D. Crosman and E. A. Phillips were then admitted to associate membership.

COMMITTEE REPORTS AND DISCUSSION.

Supervision of Standards and Recommended Practice.—This report suggested a number of minor changes in the standards to remedy the inconsistencies and faults in the drawings which have developed in practice, and included the removal of the dummy coupling from recommended practice of the Association. The committee also recommended that the following subjects be referred to special committees for investigation and report to the convention of 1899:

1. Improvement and perfection of standard top hinged lid, so that it may more completely exclude dust from the journal box. 2. To recommend forms of standard journal boxes for 3¾ by 7 inch and 4¼ by 8 inch journals, adapted for use with the pedestal type of freight car truck. 3. M. C. B. automatic couplers. To define length and spread of guard arm, and also consider the devising of a safety limit gage for determining when M. C. B. couplers and knuckles are worn beyond the limit of safety. 4. To revise the recommended practice for loading poles, logs and bark on cars. 5. Specifications for M. C. B. coupler tests.

In the discussion Mr. Higgins suggested the importance of specifying the location of the air brake defect card, and was supported by several who thought it important to insure uniformity of attachment so that repairers would know where to look for the cards. This was referred to the Committee on Standards. All of the recommendations of the report were adopted and the question of changing the standards will be referred to the membership by letter ballot.

Triple Valve Tests.—Mr. G. W. Rhodes reported that there had been no triple valves submitted for test during the year, and the fact was deplored. Triple valves were being introduced which had not been subjected to test, and the committee had considered the advisability of requesting its discontinuance rather than exist as a useless figurehead. The examination and testing of new triple valves in the future was to be important, and they should all be brought before the committee before being introduced in service. The plea for better treatment of this important matter was exceedingly able and effective. Mr. Waitt indorsed the expression of the committee, and urged action by the association looking to the indorsement of

devices which had been favorably passed upon by the committee, and no others, the moral effect of which would be to prevent the use of the cheapest devices on new cars merely on account of their being cheap. Mr. Mitchell moved to instruct the committee to obtain triple valves of all the different makes for test, and report next year. Mr. Leeds questioned whether the present triple valve tests, which were based on the best possible service, were not unnecessarily rigid. Mr. Humphrey amended the motion providing for the submission of the report to the Executive Committee, with a view of distributing the report to the members as soon as ready, and before the convention of next year. The object was to render the results of the tests available for the members as early as possible. Carried.

NOON HOUR DISCUSSIONS.

Lumber Specifications for Freight Cars.—Opened by Mr. Pulaski Leeds. Much attention was paid to the quality of lumber used and the inspection thereof. Mr. Leeds said in part:

In my opinion one size of sill is proper for any of this class of car, and as a 4 by 10 will give all the strength necessary for compression and for carrying between bearings, the principal point is to guard against the tendency to break over the transoms.

All siding and lining should be 3¼ inches face, as this can be got out from the commercial widths of four inches, and will give no trouble by shrinkage, and further is capable of being securely fastened with a reasonable number of nails. The making of siding and lining uniform enables us to use our material to better advantage, the best for siding, and inferior grade for lining. Roofing is, in my opinion, most economically worked and laid from 6-inch strips, giving a face of 5¼ inches, two nails to a crossing.

In my opinion first class yellow poplar is not only the best substitute for white pine, but fully equal, as there is nothing, so far as my observation goes, that will hold paint as well, and it also holds the nail fairly well. Many of us have to use hard pine on account of excessive cost of white pine or yellow poplar, but it is not a good substitute, where they can be obtained at a reasonable advance in cost. The argument advanced in favor of steel versus cast iron, etc., of dead weight, will apply fully to this matter of siding, and I know of nothing that is a substitute for white pine or yellow poplar where they can be obtained at a reasonable cost.

I hope there will be a discussion of the subject of standard dimensions not only as advanced, but the desirability of standard dimensions for all material constituting the framing of a car. If we could get widths and thickness uniform, the length would not be so essential, although desirable. In my opinion, all cars of certain classes should be uniformly framed; not only would we get the benefit in repairs of foreign cars without delay, but when specifications were issued (as they frequently are) calling for all lumber and timber to be seasoned on the stick for at least six months, although calling for a delivery within sixty days, they will not be so apt to call up a derisive smile, inasmuch as manufacturers could then not only stock up for seasoning and take advantage of the market, but they could well afford to build such standard cars in stock, and when offered a contract in which the delivery was the essence of such contract, would only have to letter well-seasoned cars, instead of having to pick the buds and leaves off such "seasoned" timber as will persist in growing while in process of construction into cars for prompt delivery.

The subject of standards on cars was the first point brought up and the desirability of standard dimensions was shown as it has been repeatedly for years. Mr. Higgins spoke favorably of Norway pine for siding and lining; he had had good results with it. Mr. Hennessey reported favorably on Douglas fir for sidings and roofing. Mr. Appleyard spoke approvingly of it for passenger car floors.

M. C. B. Journal Boxes, Wedges, Brasses and Lids.—Mr. H. F. Ball directed attention to the importance of providing an adjustable bearing for the brasses, to maintain a uniform distribution of the load lengthwise of the journal bearing. [See American Engineer, May, 1898, page 158.—Editor.] There was no discussion.

Air Testing Plants for Terminals.—Mr. H. F. Ball opened the discussion with a description of the new plant in the yards of the Lake Shore, near Buffalo, which was installed for about 15 cents per running foot, exclusive of compressor. Mr. S. P. Bush said that the bad condition of the brakes on many cars demanded comprehensive air brake testing plants. He had recently become convinced as to this by investigations into the conditions of brakes of cars received upon his road.

Standard Trucks.—Mr. E. D. Bronner introduced the subject which had often been up for discussion from the earliest days of the Association. He did not consider it desirable to attempt to standardize to a much greater extent than had already been done, owing to the fact that progress in improvements would be seriously retarded and difficulties would always be found in getting people to adhere to standards if adopted. The most common parts were all that could be satisfactorily standardized. The plate truck was believed to be the best type for heavy cars, and had much to recommend it over the diamond type.

COMMITTEE REPORTS.

Standard Wheel and Track Gages.—This committee presented a verbal report, stating that owing to the illness of the chairman, they had as yet made no tests and that the committee would make tests and present the results next year.

Brake Shoe Tests.—Mr. Bush stated that no tests had been made during the year and that the testing apparatus had been transferred from the works of the Westinghouse Air Brake Co. to the laboratory of Purdue University, the conditions of the transfer to be printed in the proceedings.

Rust from Salt Water Drippings.—Mr. Gibbs raised the question concerning the damage to bridges which would not be protected by the use of a tank and pipes to lead and discharge the brine at the center of the track. Mr. Higgins answered by stating that the bridges could be protected by paint and sheathing. On Mr. Waitt's suggestion a motion was made, and carried, to refer the report to letter ballot for recommended practice; this to be confined to the device shown by the committee, upon which a patent had not been sought.

SECOND SESSION.

The first business of the second session was a consideration of the report of the committee on conference with Auditors, which had been referred to the arbitration committee. The committee recommended the adoption of the report, and its transmission to the Railway Accountants' Association, with the statement that the M. C. B. Association is in sympathy with the general intent of the report, but that it did not consider itself competent to act upon the first three recommendations.

Trains Parting.—There was no report by this committee, which fact Mr. G. W. Rhodes thought was greatly to be regretted, as there was hardly a more important subject to be dealt with by the railroads. Much discussion had been held in the railroad clubs concerning the parting of trains, and a blind confidence that some one was looking after the character of the couplers seemed to prevail in the association. Though the C., B. & Q. R. R. had comparatively few accidents, the most frequent cause of those that occurred was the break-in-two. The action of one of the coupler manufacturers in the reduction of the price of couplers to a point which discouraged new companies from taking the field was commended, and also that by which the manufacturers agreed to receive any scrap material made in the form of an M. C. B. coupler. The latter practice would tend to expose those who are using inferior material, which some of the newer companies are attempting to introduce. He had even found couplers in service made of cast iron, which material was used not only for the knuckle, but for the body of the coupler itself. In case of accident with loss of life, a road putting such stuff into service was committing a criminal act, and the discovery of any such material upon the equipment of cars passing over the speaker's road should have all possible prominence. Specifications for couplers were necessary, and further than that, it was desirable that record should be kept of all break-in-twos, whereby their causes might be traced, and the difficulties removed when discovered, to the end that the couplers causing break-in-twos may be known and information may be had as to the best

material and best form of attachments. The increasing speed of trains and dangers involved therein rendered it necessary to spare no effort to provide safety.

Mr. A. M. Waitt supported Mr. Rhodes, and stated that by keeping records of failures he had been able to understand and remove a number of the causes thereof. Couplers were important enough to require the attention of a standing committee to take up the question of break-in-twos, the preparation of specifications, and the consideration of limits to the permissible wear in the couplers. There would be much for such a committee to do in the testing of new couplers, and in keeping statistics of failures. He remarked incidentally that the constant motion of the cars approaching and separating from each other on the road appeared to demand the use of buffers. The contour lines needed to be maintained, in proof of which he exhibited a blue print of a coupler, which showed that, on account of wear and the distortion of a guard arm, the bending between the knuckle and the guard arm was more than one inch, which was enough to permit the coupler to uncouple repeatedly on the road, without the lock being raised. He concluded that the amount of distortion or bending of the guard arm, and the change in the position in the knuckle, due to wear, and the thinness of the tongue, due to wear, as well as the wear of the knuckle pivot, should be limited. Gauges used by the speaker were exhibited.

Revision of Interchange Rules.

The recommendations of the Arbitration Committee had been so thoroughly threshed over in advance as to leave comparatively few matters requiring discussion, the chief of which were the adjustment of prices for repairs to cars east and west of the 105th meridian, due to the difference in cost of labor and material in the two sections of the country. The western members fought hard for a differential rate of 15 per cent. added to the labor and material charges for work done by them, to save them from the loss occasioned by the difference in the schedules. Messrs. McConnell, Humphrey, Hickey, Schlack, Dunn and Small did the talking in favor of the change, and it was shown that the labor charges west of the Missouri River were nearly 31 per cent. greater than on the eastern lines. The cost for material was from 10 to 15 per cent. higher in the West. On the other hand, according to figures given by Mr. McConnell, the mileage of Union Pacific cars on foreign lines was 41,222,483 miles, the mileage of foreign cars on the Union Pacific being 79,537,917. The Union Pacific paid out for foreign mileage $508,942, and collected for mileage on Union Pacific cars on foreign roads $248,985; these figures covering the amounts paid in the two accounts during the same time.

Mr. Bush presented an argument to show that the mileage rate paid for cars was so low as to constitute a rental which gave an advantage to the western lines, which was in part as follows:

We have an average mileage rate for ordinary freight cars which covers the entire country. That rate is six mills per mile. It is very low. The average value of a car is $400. The interest on that is $24. The average mileage of freight cars on 23 of the principal roads of the United States is 21 miles per day. That gives a mileage of 7,560 miles a year. The return rate of six mills per mile is $45.36 to the owner. Out of that he has to pay for the cost of maintenance, and included in that cost is the item of depreciation, and the renewal of cars worn out. At the very lowest four mills per mile will not cover the cost, and it will reach over five mills, as the cost of maintaining, including renewals, cars being destroyed, etc. Now assuming that it is over four mills for maintenance, that will mean $30.24 per car per year. Admitting that the revenue received from the car is $45, you have $15 as the return on your investment. The railroads west of the 105th meridian are getting the benefit of that exceedingly low mileage rate. As Mr. McConnell showed by his figures, they are using more foreign cars than the mileage of their cars on eastern roads, and his road and all the others in that section of the country are getting the benefit of that exceedingly low mileage rate, which I claim compensates them for any difference in the cost of making repairs, but even if it did not they would have to take their own equipment to do the business they are doing to-day with foreign cars. They would pay exactly the same amount of money and more to maintain their own equipment than they are paying to-day. In addition to that they could not get a fair return on their investment. The fact of the matter is, I believe the western roads are ahead on account of being able to rent cars at a low mileage rate. I cannot bring myself to believe that it is any way just to make this differential rate.

The discussion not being completed, the session adjourned to meet in the afternoon and was resumed by Mr. H. J. Small, who took the position that the matter should be settled by the association without considering the car mileage, which involved questions outside of the province of the association to decide.

Mr. Humphrey at this point gave an abrupt turn to the course of the discussion by waiving the differential on charges made to railroads, and in place of the motion which was made last year, he substituted one providing the application of the differential of 15 per cent. to be added to the cost of all repairs done west of the 105th meridian on cars not owned or operated by railroad companies. This was in effect, as was stated by one of the speakers, an attempt to waive the question of differentials against the railroads who could practice reciprocity with the western lines, and to get even in the matter by adding the cost to the private car lines who could not reciprocate.

Mr. Rhodes here made a most sensible suggestion by showing that this was a matter of great importance, which was not to be decided without deliberation and consultation with superior officers. The question was complicated and the single question of whether a differential was advisable was enough for one committee to tackle. He turned the whole tide of discussion, which from this point assumed a more reasonable, rational aspect, and immediately a number of the representatives of private car lines expressed their opinion of the motion, which was unfair to them in view of the fact that they were urged to take up the interchange on account of the benefit which they would derive therefrom. The motion was voted down, whereupon Mr. Rhodes submitted one to the effect that the question of differentials and the charges under the rules should be referred to a committee of five, consisting of one railroad man from the East, one from the middle section and one from the West, with two representatives of the private car lines. Carried.

Among the other questions in regard to prices, a committee was appointed to suggest a blanket price for all couplers used in repairs, and this committee afterward suggested a price of $7.50, which was adopted after considerable discussion. The object of this action was to remedy the present defect in the rules whereby the prices for couplers, as given to the Secretary of the association by the manufacturers, are sometimes double the market prices.

The passenger car prices were approved, and the session adjourned.

FOURTH SESSION.

The stenciling of light weights on cars was considered and placed among the committee subjects for next year.

Committee Reports.

Care of Journal Boxes.—Mr. Waitt considered a record of 2½ hot boxes per 1,000 miles an unnecessarily high one, for which there was no justification except in the most sandy sections. The Lake Shore hot box record was one hot box to 70,000 miles run in passenger service, and one to 20,000 miles in freight. Eighty per cent. of these were on foreign cars and 20 per cent. on home cars, the good record on home cars being due to insisting on knowing the causes for each case. It was necessary to exclude dust, and the common wooden dust guard was unsatisfactory, a good dust guard being worth experimenting and searching for. A good dust guard was probably to be had, and was very much needed. As to oils, summer oils should not be allowed to remain in the waste when winter oil was put in, the summer oil proving a "non-conductor" of winter oil. The

boxes should be repacked with waste soaked in winter oil. In winter many hot boxes resulted from moisture deposited in the boxes during a thaw following cold weather, and this moisture should be removed. It was worth while to remove packing from boxes when cars were undergoing repairs, and replace with good waste when they are turned out on the road.

Mr. F. W. Brazier—The plan of using saturated waste instead of oil, by inspectors, was a source of saving and prevented hot boxes.

Mr. Mendenhall defended the present wooden dust guard, but it should be a tight fit in the casting to exclude the dust.

Mr. Schroyer recommended thinning down the wheel hub and providing for a ¾ to ⅞ inch guard; the wood should be thicker. He preferred cotton to woolen waste, as a better absorbent of oil.

Mr. Leeds touched on one of the chief reasons for hot boxes when he said that many of them were caused by using bearing material for the brasses that was not fit to be used on wheelbarrows.

Square Bolt Heads and Nuts: Standards for Pipe Fittings.—This subject requiring further work, the committee was continued until next year.

Specifications for Air Brake Hose.—The report by Mr. Waitt was so complete and thorough as to leave nothing to be said in discussion. The subject will be taken up again for report at the convention of 1900.

Springs for Freight Car Trucks.—No discussion.

Thermal Tests for Car Wheels.—No discussion.

Air Brake and Signal Instruction.—The report was accepted and ordered submitted to letter ballot. It presented a number of minor changes in the rules.

Steel Car Framing.—Mr. Mitchell explained that it had been impossible for the committee to make and recommendation, which was due to the fact that only about 12 per cent. of the members were prepared to express opinions on the subject. The report was received and the subject will be taken up again in about four years.

Mr. Simonds placed the saving in the length of trains among the most important recommendations of the large capacity steel cars. He desired to see the committee continued for report from year to year, and instructed to give early consideration to the designs of draft gears and body bolsters. With trains of 2,100 tons the pull on the draft gear was 35,000 pounds on a 22-foot grade, which was 9,000 pounds above its capacity, and necessitated new treatment in designing draft gear. This ended the discussion, which was exceedingly disappointing to those who wanted to learn something about steel cars.

Passenger Car Pedestal and Journal Box for Journals 4¼ by 8 Inches.—The recommendations of the committee were first corrected in several minor points and then ordered submitted to letter ballot.

Committee on Prices.—The adjustment of prices brought out considerable discussion with regard to couplers, the result being a change from the present rule (Section 11, Rule 5) to provide for a blanket price for all couplers or parts, based upon average current prices. The matter of prices was brought up in the second session by Mr. Tracy Lyon, who objected to the present system of charging more than the current market prices for couplers. The price for couplers for the coming year is to be $7.50. Mr. J. J. Hennessey presented the arguments that carried this action through, and the credit for the result is largely due to him.

Notice was given of proposed changes in the by-laws, looking to the admission of Railroad Commissioners in the membership of the association, and to change the date of meeting to the second Wednesday instead of Tuesday in June. These changes will be acted upon next year.

The revision of the rules for loading lumber, rails and other long materials was brought up by Mr. Leeds. He presented a pamphlet giving the changes in the rules desired by the original committee, which was referred to a committee to revise the rules and confer with a similar committee of the American Railway Association.

TOPICAL DISCUSSION.

Side Bearings.—Mr. Mitchell had made tests comparing the drawbar pull on trains with side bearings in contact with others which were clear of each other, the results showing clearly the advantage of using bolsters which will keep the side bearings clear of each other.

Air Brake Details for Freight Cars.—Mr. A. L. Humphrey urged the adoption of standards for the application of air brake equipment, before the apparatus had made too great progress to make this possible. Retaining valves on 1,500 cars had been examined and only 137 of these were found in working order. Some of them were placed on an angle, which prevented the valve from operating. Standards were needed to prevent too many joints in the train pipe, and the bends of the pipes should also be systematized. Much trouble was now experienced from poor material and workmanship.

Axles for 100,000 Pound Cars.—Mr. E. D. Nelson. The large number of 100,000 pound cars necessitated the adoption of a design for a standard, and a design was submitted with a suggestion that it receive consideration by the association, with a view of submitting the design to letter ballot for recommended practice. There was no discussion and no action on the suggestion.

Height of Drawbars.—Mr. C. A. Schroyer opened the discussion by stating that three inches did not give a sufficient leeway to provide for the variation in height of couplers, considering the fact that nearly all of the wear of the wheels, axles and busses, and also the shrinkage of timbers, tended to reduce the height of the cars. An increased allowance would involve no danger to trainmen, and was badly needed to provide for wear and for increasing loads. He recommended action by the association looking to an increase in the allowance to 4½ inches from the present limit of 3 inches.

Mr. Rhodes suggested caution in this because increasing the limits would cause danger from the small amount of bearing surface left in the couplers. The result of the discussion was to order the Executive Committee to confer with the Interstate Commerce Commission.

Securing Running Boards to Car Roofs and Location of Ladders.—Mr. A. E. Mitchell described the malleable iron running board bracket manufactured by the Dayton Malleable Iron Co., and gave an excellent account of its four years of service on the Erie, during which time none had become loose. Mr. Mitchell considered the end ladder much safer than the side ladder, owing to liability of accident to trainmen on account of obstructions along the track.

Durability of Paint Sprayed by Compressed Air.—Mr. F. W. Brazier had investigated the relative condition of paint applied by air and by brush, which was invariably in favor of the air. The forcing of the paint into the surface of the wood by the impact of the jet was found to add to the durability of the paint. He gave records from the painters, and from his own observations was convinced that the air system gives better work, better service and is cheaper. A car painted and stenciled, including the track mark of the road, costs but $3.00 for labor. Mr. J. E. Simonds corroborated the experience of Mr. Brazier.

The committee on subjects for next year reported as follows:

First—Standard specifications for lumber in freight car construction.

Second—Best design of freight car door-fasteners.

Third—Standard application of air-brake appliances with a view to reducing the number of couplings in pipes.

Fourth—Best method of applying running-boards and ladders to freight cars.

Fifth—Committee to report on the advisability of allowing a differential for fixing prices for repairs done on work west of the 105th meridian.

Sixth—Perfection of top-hinged oil-box lids, so as to more completely exclude dust from journal boxes.

Seventh—To recommend standard journal boxes 3¾ inches by 7 inches, and 4¼ inches by 8 inches, adapted to use with the pedestal type of freight car truck.

Eighth—To define length and spread of guard arm, and to consider the devising of a safety limit gauge for determining when M. C. B. couplers and knuckles are worn beyond a limit of safety.

Ninth—To revise the recommended practice of loading poles, logs, bark and other structural material on cars.

Tenth—To report specifications for M. C. B. couplers.

The election of officers resulted as follows:

President, C. A. Schroyer.

First Vice-President, John T. Chamberlain.

Second Vice-President, J. J. Hennessey.

Third Vice-President, W. J. Robertson.

Executive Committee: E. D. Bronner, J. H. McConnell, William Apps.

Treasurer, G. W. Demarest.

Mr. Blackall stated that Mr. Bronner had declined the nomination for the presidency.

Mr. Schroyer addressed the convention in a happy manner, after which it was adjourned at 1.30 p. m., Friday, June 17.

THIRTY-FIRST ANNUAL CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

The convention was opened with prayer by Bishop Newman, followed by the address of President Leeds. Satisfaction was expressed at the selection of Saratoga as a place of meeting of the association for the fourth time. The value of technical education was appreciated as a preparation for railroad service, and the student was specially needed now. The combination of technical and practical study was seen to be the only way to prepare young men for successful work. The advantages of holding the Master Car Builders' and the Master Mechanics' Association jointly occupied a prominent place in the address, and consolidation of the two associations was suggested. The comparative merits of different types of locomotives should be determined by a committee of the association, the plan suggested by the President being somewhat similar to that outlined in the discussion of this subject by Mr. M. N. Forney, on page 198 of our June, 1898, issue.

The report of the Secretary, which was then read, showed the present membership to be, active 598, honorary 26, and associate 18, a total of 642. There were no funds in the hands of the Secretary, and all bills had been paid. Two of the three association scholarships at Stevens Institute of Technology were now taken, and would be vacant again in two years. The members who had died during the year were:

J. F. Bryant, A. A. Daniels, F. J. Ferry, J. M. Hurst, D. G. Mott, P. H. Schrieber, J. P. Seward, Wm. Lannon, F. Mulligan and R. B. Harding.

The Treasurer's report was read and approved.

Messrs. Edward C. Bates and G. M. Basford were elected to associate membership, after which the association voted to accept an invitation from the Schenectady Locomotive Works and the General Electric Co. to visit the works of those firms at Schenectady, the Delaware & Hudson Canal Co. having offered transportation for members and guests.

The following names were ordered placed on the list of honorary members: Messrs. James Maglenn, Edward L. Coster, M. N. Forney and J. I. Kinsey.

REPORTS OF COMMITTEES.

Tonnage Rating.—Mr. W. H. Marshall opened the discussion by asking the committee to what extent the actual weighing of cars was recommended. He had found only five per cent. difference in figuring the weights and actually weighing cars, the weight of the loading being added to the stenciled light weight of the cars. Mr. Henderson had found more difference than this.

Mr. Manchester spoke of the effect of the condition of the tires of engines on the rating. The easiest and quickest method of obtaining engine rating would be selected for use, and uniformity in classes of engines for each division would assist in making up trains and would help the yardmaster. Many changes in profile and alignment had been discovered by the use of dynamometer cars.

Mr. Wm. Forsyth spoke of the changes in profile, which were not kept up to date on engineers' records. The question of variable speed introduced another factor in the result obtained, which affected the value of the velocity head. The subject was the most important of all having to do with handling freight. The report of the committee was to be commended, and cooperation of the mechanical and transportation departments in train loading would produce many good results in the improvement of track to promote economical operation.

Mr. Humphrey, being connected with a road among mountains, had found it necessary to rate engines on down as well as up grades. He had found serious discrepancies in the profile records on his road. He did not make any deductions for condition of engines, but allowed 10 per cent. reduction for winter ratings. He had found by experiment that five tons per car should be added for each empty car.

Mr. Henderson then closed the discussion. He showed that the report had considered the question of profiles. Profiles were not always correct, but this should be looked after before using them in tonnage rating.

Best Methods of Boiler and Cylinder Insulation.—Mr. Wagner suggested that the committee should be continued on account of further work that might be done to add to its value.

Mr. Quayle explained that for some years he had protected locomotive steam pipes by their location in the saddles. The spaces were filled in with mineral wool, held by a plate. The proportions in the mixture of plastic coverings was important, and also its age in service. Some coverings improved by age. He used equal parts of asbestos, lime, slacked, and sawdust. Plastic coverings were preferred to sectional coverings, owing to the possibility of air currents taking heat away very rapidly when spaces were left open.

Mr. Browne reported favorable experience on the Pennsylvania with sectional coverings, except such portions as could not be covered by it. In these cases it was softened and applied in the form of plaster.

Mr. Marshall thought the results shown by the curves were not accurate on account of the loss by radiation from the water into the room. Also wood lagging was shown in the curves to be one of the best of the coverings, which reflected against the accuracy of the tests.

Topical Discussions.

The Special Apprentice.—Mr. Robert Quayle: Special, technically educated apprentices were growing more numerous. The regular apprentice, when of the right sort, need not be far behind the educated man. The best of each kind rapidly went to the front, and it was important to find what they were best adapted for. They were very satisfactory and especially on test work. They were paid more than regular apprentices, and after spending much time and money in study they were entitled to higher wages than the regulars, and were paid $1 per day at first. The regular apprentices were offered equal advantages when ready to take similar work. There was no regular programme laid out for the specials, but they were given opportunities to thoroughly learn the shop methods. The members were urged to try the plan.

Mr. McKenzie believed it a good plan to start boys as laborers, rather than as privileged apprentices.

Mr. Marshall suggested the value of special apprentices in connection with special investigations and reports.

Locomotive Front Ends.—Mr. McConnell stated that the best arrangement of front ends depended upon the character of the fuel. Front ends clogged by cinders meant poor steaming. Lignite coal was difficult to use, owing to the difficulty in keeping the front ends clear and preventing spark-throwing, while at the same time obtaining free steaming qualities. The diamond stack, large nozzles and petticoat pipe could be combined to burn Wyoming coal with good results without throwing sparks. After five years' experience with extension fronts the ordinary front end and diamond stack was used to replace them, the results being very satisfactory.

Technical Education.—This discussion, opened by Prof. Hibbard, turned on the value of technical education to young men entering railroad work. The substance of the whole question was admirably put by Prof. Goss as follows:

There are several views to be taken of such a subject as this. A large view should prompt us to look upon the work of an educational institution as the work of drawing out and making larger men. There is a disposition always, when we think of technical work in schools, to connect them with the notion of the trade school. The trade school is an important factor in our educational system; but when we speak of our technical schools we do not think of a trade school, and the purpose of these schools is not to teach trades. It is for that reason we do not educate trainmen in our schools. That would belong to a trade school in railroad engineering. But we are developing men all the time. It was developed in the

discussion of the special apprentices that master mechanics don't regard the things that a man has learned in the schools. You don't credit him with being a machinist or a locomotive engineer, but you do find that that man can do things for you which the regular apprentice cannot do. He has power of thought and of absolute action which the regular apprentice does not possess. With his power, which has been obtained in the technical schools, it seems to me that we should keep in mind all the time that he has received the fundamental basis of knowledge upon which can be grafted the practical knowledge of the business with much greater success than in the case of one who has not received such a technical education.

Second Session.

Committee Reports.

Square Head Bolts and Nuts; Standard Pipe Fittings.—This was a report of progress, and it required further work, including the design of a complete set of standard unions, which necessitated conference with the manufacturers and the American Society of Mechanical Engineers. More time was asked for and granted.

Improved Tools for Railroad Shops.—Mr. T. R. Browne read this paper, which was printed too late to be distributed before the meeting. The paper called attention to the advantages of milling machines, turret lathes, cold saws, power hoists, and all of these combined with improved methods, shop methods being not less important than the tools.

The discussion was opened by Mr. Gaines, who favored the use of the milling machine. He had found an advantage of 50 per cent. in a comparative test between a milling machine and planer on keyway work, this being a confirmation of one of the conclusions of the committee.

High Steam Pressures.—The substance of the report was briefly presented by Prof. Goss. This was one of the best reports presented, and it drew out considerable discussion.

Mr. Henderson opened the discussion by showing that with longer runs and shorter time at terminals anything requiring delays for necessary work on boilers was objectionable. Quantity of work done by engines was more important than saving of fuel. If high steam pressure permitted the pulling of more cars it was good, but if it caused more repair work its advantage was questionable. Piston valves were strongly endorsed. Large boilers were more economical than small ones. They did not increase tractive power, but more power could be exerted at higher speeds. A locomotive boiler could not be made too large.

Mr. Tracy Lyon presented figures on repairs to boilers for pressures of 145 to 160 pounds, as compared with those on those carrying 160 to 175 pounds. It was particularly noticeable in connection with flues and staybolts, high pressures showing an increase in cost of repairs. Figures were quoted from one road showing an increase of 44 per cent. in flue and staybolt work on locomotives carrying 165 pounds pressure as against those carrying only 145 pounds in the same time.

Mr. Gaines did not believe it necessary to have more repairs with 200 pounds pressure if the designs were correct.

Mr. Marshall did not think sufficient experience had been had to show the effect of higher pressures on repairs. The high-pressure boilers had the advantage of improved tools and methods of working. The staybolt breakage and the repairs to new boilers specially designed to carry higher pressures were lower than before high pressures were used. The boilers were now better made. As regards long steam ports, the C. & N. W. practice was to reduce 20-inch ports to 16 inches, and good results had followed the change. Boiler capacity was very important. Very heavy engines with large heating surfaces were found more economical than small ones with restricted heating surfaces, and this was true even when the large engines were lightly loaded.

Mr. Forney emphasized the principle that within the limits of size and weights the boiler could not be too large. The relations between heating surfaces, grate areas and firebox volume were exceedingly important, and there were advantages in getting large volumes in fireboxes. Early experiments had shown that it was a good thing to restrict the grate area. The proportion of fuel burned was a subject concerning which more experimental work should be done. Judicious use of dead plates was probably to be made a means of very great improvement in economy. Combustion chambers had often been tried and frequently abandoned probably on account of faulty circulation. They were valuable in connection with the proper proportions of heating surface and grate area, and a satisfactory design was probably to be had. The boiler should not be neglected in favor of the engine.

Mr. David Brown testified to the continual troubles had with combustion chambers. He believed it important to prevent air from entering the firebox at the edges of the grates without going through the fire.

Mr. Wm. Forsyth emphasized the effect on the capacity of locomotives by increasing boiler pressures, which improved them as "hauling machines," and higher pressure as well as larger boilers would contribute to that result. Mr. Forsyth thought the best pressure was between 160 and 200 pounds, and thought it desirable to locate the best pressure definitely. He considered 180 pounds the upper limit for simple engines, this being based on experience with that pressure in freight service. He had found compounds to show 15 per cent. better economy than simple engines at that pressure. He did not know any upper limit to the compound.

Prof. Goss closed the discussion and stated that the subject was the efficiency of high-pressure steam and not the efficiency of locomotives carrying high-pressure steam. By vote the subject was referred to the committee on subjects with a view of further work in the same direction.

Cylinder Fastenings.—This report was accompanied by a supplementary report by Mr. J. E. Sague, being substantially a minority report, which resulted from impossibility to hold a meeting of the committee. The discussion was opened by Mr. R. Atkinson, who several years ago had found the necessity for better securing of cylinders to smoke boxes, and now used 21 bolts for this joint, and he had also found it necessary to reinforce the joints of mogul frame splices.

Mr. Henderson discussed the importance of providing for strains while engines are pushing trains and in being lifted in the shops. Keys between the cylinders were important to prevent cylinders from working upon each other.

Mr. Gaines called attention to the importance of providing for the expansion of the saddle castings, due to the effect of the heat from the inside and the cold outside. Expansion pockets were made in the castings to take these stresses from the bolts.

Topical Discussions.

The Use of Steel in Locomotive Construction.—Mr. Sague reviewed the progress of the use of cast steel. The effect of using it was to lighten the running gear and other parts to permit of putting more weight into the boiler. Some of the objections to its use were noted. Increased shop labor, delay in working in the shop, and delays due to defective castings, were mentioned. The first cost of construction was increased, but the result was a gain.

Mr. Henderson spoke of nickel steel for axles to secure lightness with reduced weight, and asked for information as to the heating of journals of nickel steel axles. The question was not answered.

The discussion then took the form of comparisons between forged steel and iron for axles. The Coffin process for axles, piston rods and crank pins was highly spoken of. European practice generally employed steel in place of iron in axles, and we would be driven to it, as Mr. MacIntosh said, "by the increasing use of steel, which rendered it difficult, if not impossible, to get scrap iron that would be entirely free from

steel." Early prejudice was difficult to overcome. The use of nickel steel was not extensive enough to warrant drawing conclusions.

Electric Traction.—Mr. P. Brangs supplemented his paper read at Old Point Comfort last year with a description of three phase current apparatus and comments on electric traction.

The session adjourned to take a special train for Schenectady, where the Schenectady Locomotive Works and the plant of the General Electric Company were visited. The attendance on the excursion was large, and the members found much to interest and instruct them at both establishments.

In the evening of June 21 Prof. Goss delivered a lecture illustrating by aid of stereopticon the Engineering Student at Work. It was an earnest, painstaking and able presentation of the work and the ideals of the engineer, his preparation for research work, his studies and practice, and the selection of his life work. He was shown in the class room, the laboratory and the workshop, the speaker's intention being to enable the members of the Association to understand the meaning of the education of mechanical engineers. The views were nearly all from Purdue University. The lecture was thoughtful, instructive, suggestive.

CLOSING SESSION.

The usual resolutions were disposed of, and, acting upon the report of the joint committee on Revision of Air Brake and Signal Instructions, instructions were ordered that when the pamphlet is printed it shall be stated that the revision has the approval of the Master Mechanics' Association.

Report of the Standing Committee on Apprentice Boy.—Mr. Bradley spoke of the suggestion that the subject should be taken up with other societies, with a view of uniform action, and Mr. Peck offered a resolution covering this, which was voted down.

Mr. Wagner emphasized the value of the work of night schools and from his experience believed that there would be no difficulty in raising funds for their maintenance in a community where mechanics and apprentices were employed. He had started such a school six years ago, from which gratifying results were obtained. Mr. David Brown indorsed what had been said with regard to the educational features and thought that the report should be criticised on account of having the boys with the men so much of the time. He would place the boys on their own responsibility, and change them from one machine to another until proficient, allowing them to finally remain in the shop which they should choose.

Mr. McIntosh believed that the committee had outlined an ideal plan, which should be followed whenever practicable. It should be adapted to the conditions of various shops, and used as an outline or guide. Mr. Tonge thought that the education should be adapted to the capacity of the boys, and believed that all apprentices should be treated alike, in order to avoid a lack of harmony among them.

Mr. Quayle did not agree with some of the previous speakers, particularly in regard to treating the apprentices all alike. He would not have a fixed rule for progress, but would advance each one according to his fitness for the work, upon the basis of "merit ought to win." Apprentices with technical education were usually older than regular apprentices, had maturer judgment and superior ability, which should enable them to push ahead of the others, and he did not believe in holding a boy back if he had ability. The report provided a plan which could be made sufficiently elastic to meet the conditions of any shop. Night school education was to be encouraged, and it was noted that probably many members of the association had been obliged to work hard at night in their own education.

Mr. Wm. Forsyth moved that the code should be adopted, not as a standard, but as a plan recommended by the association. The code of apprenticeship was not suitable to all conditions, and should not be adopted exactly as it stood. The result was an indorsement of the code without making it the standard of the association.

Suggested Consolidation of the Two Associations.—Mr. Setchell read the report of a special committee, appointed to consider the recommendations contained in the President's address. The committee confined itself to the suggested consolidation, and favored bringing the two associations under one organization as being timely and practicable. A large proportion of the car mileage represented in the Master Car Builders' Association was controlled by Superintendents of Motive Power or Master Mechanics who are members of the Master Mechanics' Association, in which all Master Car Builders are eligible to membership, and there was no good reason why all business pertaining to the construction and repairs of engines and cars should not be transacted in one association and at one convention. Time and expense to the railroads would be saved, and fully as much work might be done in four days as now in six. The committee recommended that the executive committee of the Master Mechanics' Association should at once confer with the executive committee of the Master Car Builders' Association, and endeavor to arrange for a consolidation, which would do full justice to both associations, and it was provided that the President of the Master Mechanics' Association should appoint a special committee, who should also be members of the Master Car Builders' Association, to present the subject for consideration at the next Master Car Builders' Convention. Adopted.

Subjects for 1899.—The committee on subjects for the next convention, which was referred to the executive committee, was as follows:

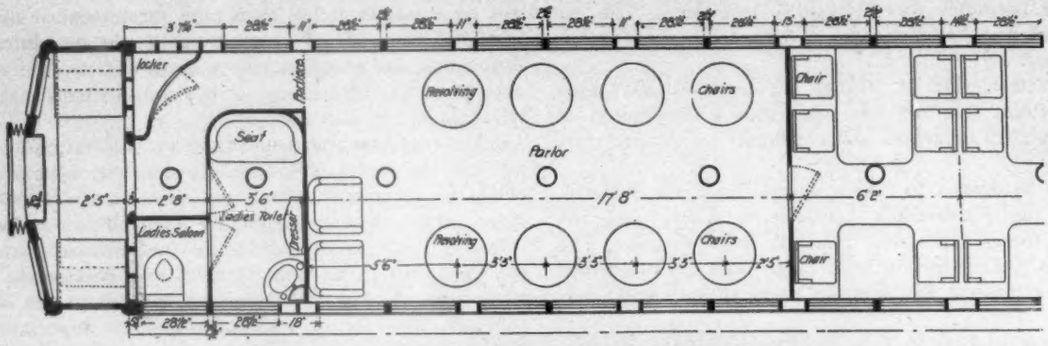
1. A research laboratory under the control of the American Railway Master Mechanics' Association.
2. Water purification and the use of boiler purge.
3. Cast-iron vs. steel-tired wheels for passenger equipment.
4. The advantages of the ton-mile basis for motive power statistics.
5. What is the best method of applying stay bolts to locomotive boilers, including making the bolts and preparing the stay bolt holes?
6. Is it advisable to have flange tires on all the drivers of mogul ten-wheel and consolidation engines? If so, with what clearance should they be set?
7. Is it good practice to make locomotive fire-boxes with the crown and side sheets in one piece?
8. The use of nickel steel in locomotive construction; its advantages and proper proportion of nickel.

A motion made by Mr. Setchell was carried, authorizing the executive committee to change the date of the meeting for next year to suit the necessities of the association. Detroit, Lakewood, Old Point Comfort and Denver were suggested as places for holding the next meeting. The election of officers resulted as follows:

President, Mr. Robert Quayle.
First Vice-President, Mr. J. H. McConnell.
Second Vice-President, Mr. W. S. Morris.
Third Vice-President, Mr. A. M. Waitt.
Treasurer, Mr. J. N. Barr.

Each of the newly elected officers, except Mr. Barr, who was absent, addressed the convention in a few words, and in the remarks by Mr. Waitt it was made to appear significant that a Master Car Builder had been elected an officer in the Master Mechanics' Association. A number of the topical discussions were laid over until next year, owing to lack of time, and after a brief address by the retiring President, Mr. Leeds, the convention adjourned.

The proportion of locomotive and tender resistance to the total resistance of trains averaging 160 tons in weight and locomotives with tender weighing 85 tons more, as taken from data in a very elaborate series of tests on the Northern of France Railway, is about one-half the total, says "Engineering."



Parlor-Cafe Car, Illinois Central Railroad—Half Plan.

Illinois Central Parlor-Cafe Car.

Interior of Parlor.

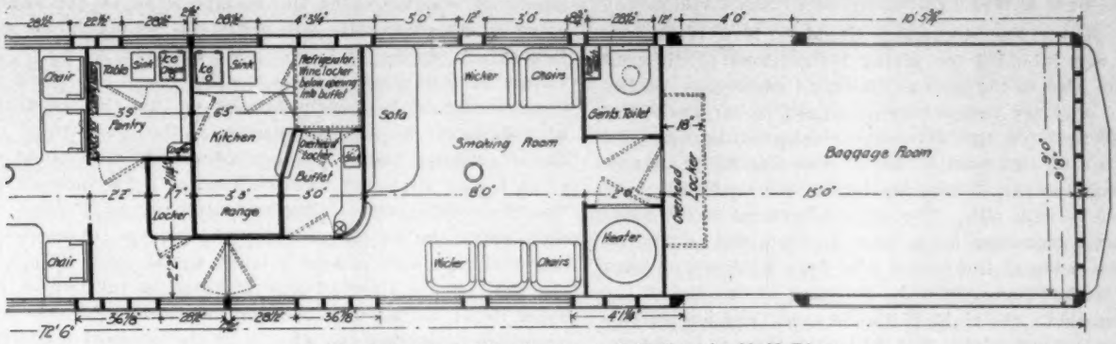
Interior of Cafe Room.

COMBINATION CAFE, PARLOR AND BAGGAGE CARS, ILLINOIS CENTRAL RAILROAD.

The new train designated as the "Daylight Special" of the Illinois Central Railroad, now running between Chicago and St. Louis, includes an interesting car, which is a combination of dining, parlor and baggage accommodations in one car. Two of these have recently been furnished by the Pullman Palace Car Company, of Chicago.

The length of the car over sills is 72 feet 6 inches and the width over the sills is 9 feet 8 inches. The total length is 77 feet 3 inches, and the weight is about that of an ordinary Pullman sleeper. The plan view shows that there is no front platform, that end being "blind," while the rear end is provided with a Pullman wide vestibule and a Session's steel platform, with National couplers. The lighting is by Pintsch gas, and the outside finish resembles the standard Illinois Central equipment, the inside finish being of mahogany.

The arrangement of the car brings the baggage compart-



Parlor-Cafe Car.—Illinois Central Railroad.—Half Plan.

ment, a room fifteen by nine feet, at the front end. In the rear of this is a smoking-room, with five chairs and a sofa, To the rear of this and at the left of the passageway is the kitchen, which, though small, is complete in its appointments. The dining-room, or café, is in the rear of the kitchen. It is twelve feet long and has seats for twelve persons at four tables. Beyond this is the parlor compartment, with ten chairs, and the rear end is given to the ladies' toilet rooms. A good idea of the exterior and interior of the car is given by the half-tone engravings.

The framing is the Pullman standard, cantilever truss, with four truss rods. The roof is also standard, with square deck. The inside finish is of mahogany throughout, except the baggage compartment, which is finished in white wood. The ceiling is three-ply white wood, and the ceiling decoration is in color and gold. The heating is by steam, using the Safety Car Heating and Lighting Company's equipment, with New York Safety couplers. The trimmings of the car are of bronze; the brakes are by the Westinghouse Air Brake Company; the brake beams are the "Monarch"; the axles are of hammered scrap with 4¼ by 8-inch journals. Paige 38-inch wheels are used. The wheel base of the trucks, each of which has six wheels, is 10 feet 6 inches.

We are indebted to Mr. William Renshaw, superintendent of motive power, and Mr. F. W. Brazier, assistant superintendent of motive power of the road, for the information and to the Pullman Palace Car Company for the photographs and drawing of the floor plan.

HEIGHT OF DRAWBARS.

In discussing the question arising from the difficulty in keeping within the limits required by law as regards the height of drawbars, Mr. C. A. Schroyer, Superintendent of the Car Department, C. & N. W. Ry., made the following remarks before the M. C. B. Association:

"When cars equipped with both automatic and link and pin bars must be coupled together, the element of danger is increased in proportion to the variation in height of draught lines, due to the limited space in the opening of the knuckle face. These conditions are changed when there is no longer any necessity to go between the cars to use the links. I am of the opinion that the limit of three inches now allowed by law may safely be increased without in any way increasing the element of danger to life or limb in handling the cars. This being so, the questions involved, aside from the legal ones, are of a mechanical nature, and the handling of the cars safely in the movement of trains.

"I believe you are all familiar with the troubles, delays and expense now occasioned in maintaining the heights required. This is due to the amount of wear the wheels, journals and brasses are subject to. The additional lowering due to set of springs both permanent and under the load, the shrinkage of sills and draught timbers, the loosening of bolts and nuts, the bending of carrier irons, the manner of trimming load, etc., all affect the draught line to such an extent as to lower it below the minimum limit of cars built to 34½ inches, thus necessitating their being raised within a very short time. This in many cases must be done in a makeshift manner, unless construction is such as to enable change to be made without blocking. Natural wear of parts, shrinkage of timber, set of springs are so great that cars in service two or three years require raising.

"The face of the knuckle will average in width about 9 inches. When two cars are coupled together, one of which is the minimum height under the load, the other the maximum height empty, there still remains 6 inches of contact between the knuckles. The variation in the minimum and maximum height of draught lines may be safely increased from 3 to 4½ inches, when we have yet remaining 4½ inches of contact, when a car of minimum height is coupled to one of maximum. I think that this will be ample for all purposes in the safe handling of trains.

"Inasmuch as it is not necessary for brakemen to go between the cars in coupling, there is no element of danger in the switching yards. All of the railroads are doing their utmost to keep the draught lines within the limits required by law, and yet statistics show that many cars in service to-day vary much from the requirements, due largely to the conditions mentioned above, and multiplied by the manner of loading and the condition of tracks. I know of no trouble being occasioned by variations of 4½ inches, and believe that automatic bars as constructed to-day will permit of a safe variation of the amount mentioned above when all cars in service are so equipped.

"I have said nothing regarding the heights of drawbars or the percentage of drawbars, the lines of which are above the the maximum or below the minimum. We have found much difficulty in getting cars of the proper height. We have furnished drawings to one manufacturing concern, and when the car was completed the draft line was just right, 34½ inches. In the case of another company the draft line was nearly three-fourths of an inch above. The discrepancy was brought about by one-eighth of an inch here and one sixteenth of an inch there, and these small deficiencies are hard to overcome in the construction of a car. I wish it could be found possible to have the limits increased from three to four and one-half inches."

The proportion of large ships in the English navy is not nearly as great as is generally supposed. Sir William H. White, Chief of the Construction Department, in an article in the "Nineteenth Century," says: "Taking the 190 ships of the English navy, it may be interesting to arrange them according to displacement tonnages. There are 22 ships over 14,000 tons; all but two are battle ships; the exceptions are the "Powerful" and the "Terrible," cruisers. Between 12,000 and 14,000 tons there are 11 ships, seven battle ships and four cruisers; between 10,000 and 12,000, 10 ships, two being battle ships. Twelve cruisers are from 6,500 to 9,100 tons, 24 between 4,000 and 5,800 tons, 46 between 2,000 and 4,000 tons. Between 1,000 and 2,000 tons there are 22 vessels, and 43 are less than 1,000 tons. Little more than one-fifth of the total number are over 9,000 tons."

NORFOLK & WESTERN INSTRUCTION CAR.

By G. R. Henderson, Mechanical Engineer, N. & W. Ry.

This car was intended for giving instructions at different points on the road to the various classes of employees. It can be used not only for instruction in regard to air brake apparatus, but also for the different systems of heating and lighting in use by this road. The car was originally a single side door baggage car 40 feet 9½ inches over end sills by 9 feet 9 inches over side sills. The old arrangement of the doors and windows, consisting of a door at each end, a sliding door four feet wide at the center, and four windows on each side of the car has been retained. Entering at one end of the car immediately to the right is a toilet room, and joining this is a desk for the instructor, who will have the car in charge. Beyond the window which lights the desk is a complete outfit of the commingler storage heating apparatus in working order, which has the commingler and all the working apparatus elevated from the floor so that it can be freely inspected on all sides and operated by the classes being instructed. Secured to the wall over this working outfit is a sectional model of the commingler, which has the various cocks and valves connected to a section of pipe line, showing the valve at the end of the car and the steam hose. Above this on the wall or side of the car is fastened one of the illustrated cards of instruction for working the commingler storage apparatus This type of apparatus is used in heating the passenger cars of this company.

Norfolk & Western Ry.—Instruction Car.

Beyond this is located a stove for heating when steam is not available, and adjacent to the stove is a model of the Leach sand apparatus, which is used on many locomotives. Beyond the side door at the center of the car, on the same side, is located the locomotive and tender equipment of the air brake apparatus, consisting of a reservoir, air pump, governor, engineer's valve, two driving brake cylinders, and tender brake cylinder, with proper auxiliary reservoirs, triple valves, etc. The piping is so arranged that the air pump can be worked by compressed air from an attached engine or the air of the engine can be forced directly into the main reservoir without passing through the air pump. This will be readily understood by the photograph, in which the lower pipe in the upper corner on the side of the car supplies the air from the engine. By means of suitable cocks the manipulation of the engineer's valve on the locomotive will apply the brakes in the instruction car.

Near each of these various working parts is located a sectional model of the various fittings, so that the operation can be understood by an examination of the "intestines" of the model. Beyond this working apparatus is a sectional model of an 8 inch air pump, and the head of a 9½ inch air pump. There are also various diagrams attached to the side of the car illustrating the different parts employed. Connected with the working outfit is also a train signal valve and whistle, operated by five lines of pipe attached to the ceiling of the upper deck; all have independent whistle valves, and are all connected to operate the whistle in the locomotive equipment. Returning on the other side of the car, we have in the corner a small work bench and vise, and adjoining this five freight car brake cylinders and reservoirs secured to the side of the car in a vertical position, coupled up for working, and one cylinder and reservoir cut in section. Beyond this is a passenger car brake cylinder, with its detached auxiliary reservoir, the whole equipment being connected with six lines of train pipe supported from the upper deck and provided with proper cocks and couplings. In order to show the effect of additional length of train pipe, two additional reservoirs are placed under the car, connected with the train pipe by the vertical pipe which will be seen running down the side of the car.

Continuing on the same side, at the center door we have a sectional model of a locomotive lubricator and adjacent to that a direct steam heating coil, which illustrates the method employed in heating baggage and postal cars. This is also connected with the steam train pipe under the car, in the same manner as the commingler storage system is connected on the other side, and together with the latter illustrates the two methods of steam heating in use on this road. A sectional model of a Monitor injector, with dragram showing the different parts numbered is next in order, followed by the regulator, gauges, etc., of the Frost system of lighting by means of compressed air. A pipe leads to two carburetors on the roof, one of which supplies a Gordon-Mitchell, and the other a Siemens-Lungren lamp in the center of the car, as will be seen in the photograph.

It is the intention later to provide a vertical boiler for operating all this equipment, but for the present this has been omitted, and power must be supplied by the locomotive coupled to the car. This arrangement of having all the apparatus on the sides of the car gives a great deal more room for the instruction classes, and this can be readily appreciated by those who have used cars in which the center is filled by freight car brakes.

The spacious and roomy appearance of the car is well shown by the photographs, yet it must be borne in mind that this car is only 47 feet long.

THE STRENGTH OF TIMBER—A DISCOVERY.

A direct relation between the compression and transverse strength of timber has been discoverd by Mr. S. T. Neely, an engineer engaged under Mr. B. E. Fernow in the investigation of strength of timber for the Government. Mr. Fernow described the results in a paper before the American Institute of Mining Engineers, from which the following paragraphs are taken:

Norfolk & Western Ry.—Instructional Car.

1. It is established by theory and by extensive experiments that, in a beam loaded in the middle, the distortions are not only proportional to the load, but are equal on the compression side and the tension side of the neutral plane until the elastic limit has been reached.

2. From the study of strain-diagrams and data of several thousand tests it appears that the elastic limit of a beam has been reached when the extreme fiber-stress becomes equal to the compression strength of the material; in other words:

3. The cross-bending strength at the elastic limit is practically equal to the compression strength at failure, and we need only to determine the latter to have at once a safe basis for the designing of wooden beams.

This is the practical result: That the necessity for tests is reduced to a minimum, and no doubtful formula need be introduced in utilizing the test data. Since no beam should be designed to be strained beyond its elastic limit, nothing but the compression strength needs to be known for practical purposes.

Nevertheless, Mr. Neely has followed up the further behavior of the beam to rupture, has developed methods of determining the position of the neutral plane at any time until rupture, and has also shown how to calculate from a compression test the beam strength at rupture.

Other important results and deductions from these series of tests may be stated as follows:

1. Wood testing should be done preferably on green or soaked timber, thus eliminating the variable influence of moisture on strength, which begins to assert itself when the moisture is below 32 per cent.

2. A well-planned series on small laboratory sizes furnishes more reliable standard and average values for practical use than tests on large beams and columns. This conclusion is the result of some 60 tests on large beams, and over 100 tests on large columns, compared with over 1,000 tests on small pieces cut from them.

3. The best size for compression pieces to furnish the most uniform results is a cube of 2 or 3 inches.

4. A difference of 10 per cent. in compression-strength values for conifers, and of 20 per cent. in hardwoods, cannot be considered as a valid difference for practical purposes, being chargeable to the natural variability of the material.

5. Wood compressed across the grain increases in strength comparatively, and does not lose its strength in endwise compression, pieces compressed to 50 per cent. of their original height exhibiting as much compression endwise strength as uninjured ones.

CAR SIDE BEARINGS.

Owing to the constantly increasing loads carried by freight cars, the question of whether the center plate should carry the whole load or should the side bearings be utilized to support portions of it, has become an important one, in which forms of frictionless side bearings are involved. In considering the objection to running cars with ordinary side bearings when these are in contact, Mr. A. E. Mitchell offered the following interesting figures before the Master Car Builders' Association at the recent convention, which we shall comment upon in a later issue:

"On the question of side bearings I have some data that may be of interest to the association. In November, 1897, we made a test with a dynamometer car on two trains, one of which

weighed 2,115 tons, and the other 2,114 tons, a difference of only one ton. The percentage of cars equipped with Fox trucks and metal body bolsters in one train was 100 per cent., all of which were center bearing. The other train was composed of diamond trucks and wooden body bolsters, only 12 per cent. of which were center bearing. There was no wind blowing, and both days on which the tests were made were as nearly alike as possible. The make-up of the trains was as follows: Number of cars in the first train, 22; in the second, 23; number of loaded cars in the first train, 21; in the second train, 22; number of empty cars in each train, 1. Length of first train, 834 feet; length of second train, 866 feet. Average drawbar pull, pounds per ton in first train, 12.84; in second train, 13.89, or 7.6 per cent. decrease in favor of first train. The average speed, miles per hour, first train, 11.97; second train, 11.13, an increase in favor of the first train of 7.5 per cent. The average boiler pressure, pounds per square inch, first train, 128.7; second train, 127.03, or an increase in favor of the first train of 1.1 pounds. The average reverse lever position, number of notch in the first train, 10.17; second train, 9.3, or an increase in favor of the first train of 9.3 per cent. The average coal burned per hour of actual running time, in pounds, first train, 2915.4; second train, 3177.5, a decrease in favor of the first train of 8.3 per cent. These figures show you the enormous saving which can be made if the cars are all center bearing."

PATENTS IN CHINA.

There is no patent office in China, and there is no treaty on the subject of patents between the United States and China. Minister Denby, writing from Peking, last February, said that, should disputes relating thereto arise between American citizens in China, they would be tried before the American consuls and decided according to the law of the United States. A patent held valid in the United States would be so held in China in all cases in which Americans are interested.

With regard to native Chinese, they stand in all these matters in the same relation to American citizens as the inhabitants of any foreign country. The international recognition of rights to patents, trade-marks, etc., depends entirely on treaties. In the absence of such treaties, there is nothing to prevent American books being reprinted, American trade-marks copied and native products sold under them and American patented goods reproduced by native workmen. The native laws, however, give remedies for fraudulent representation or obtaining money under false pretenses. I have on several occasions applied to the Chinese Government to furnish protection against the fraudulent use of American trade-marks. In each case energetic action has been taken by the local magistrates, and the perpetrators of the frauds have been punished and damages assessed.

Beyond such preventive action, I do not see how under existing treaties and laws the Government of China can do anything.

As between Americans and foreigners, these rights in China would depend on any treaties which the respective governments may have entered into regulating the protection to be afforded by their respective countries.

There is no objection to your selling to any railroad company the right to use your patent. Should the patent be afterward used by any other person without the right having been granted by you, you should appeal to your consul for redress. He would, if necessary, bring the matter to the attention of the legation.

TOOL RACK FOR FORGE SHOP—PHILADELPHIA & READING RAILWAY.

A convenient rack to hold all anvil and long-handled blacksmiths' tools, with a drawer for sand and borax and a cast iron vessel for water, is a good thing in forge shops. The one illustrated is in general use at the Reading shops of the Philadelphia & Reading, and was made from a sketch drawn by Mr. E. E. Davis, assistant superintendent of motive power of the road, some twenty-six years ago, while he was working in a blacksmith shop during a summer vacation. The sketch recently turned up in a search through some old papers, and was put into practical use at once, the result being so satisfactory as to warrant showing it to our readers.

The rack has three legs carrying at the top ends a flat plate perforated to receive the shanks of the anvil tools, while the handles of the hand tools are thrust between two circular rings of ⅝ inch round iron surrounding the plate, and supported by lugs, which in turn support the plate from the legs of the stand. The top plate is 31 inches high, and about 18 inches from the floor a second perforated plate is supported, under which are two drawers, one for sand and the other for borax. The whole thing is cast iron except the two rings, and under the rack is a cast iron water bucket. The saving of time of

A Forge Shop Tool Rack.

the men in not being obliged to hunt for tools, and the saving of floor space in the shop, are important items, and in addition to these it is very easy for the foreman to note the condition of the tools at a glance, and the men do not need to stoop for the tools. The racks are neat and cheap, no machine work being required, and the idea merits a place in every blacksmith shop. Mr. Davis has them in use at about forty fires, and says: "I am sorry to say that 75 per cent. of our smith shops to-day are run about like the one run by 'the old man' when I was a boy."

CAST STEEL IN LOCOMOTIVE CONSTRUCTION.

In one of the noon hour discussions before the Master Mechanics' Association Mr. J. E. Sague presented the following comments upon cast steel in locomotive construction and the progress which has been made in its application:

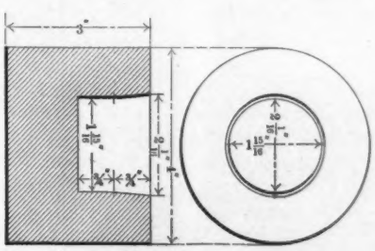
"Cast steel has became a most important material of locomotive construction, and the past year has witnessed marked improvement in its manufacture and in the design of parts made of it. Probably the main advantage obtained by the use of cast steel in locomotive work is that it has permitted considerable reduction of weight in various details, and has then allowed more weight to be put into the boiler. This, especially in passenger locomotives, has increased the efficiency of the machine by allowing the use of an amount of grate and heating surface which would be practically impossible within permitted limits of wheel weights if a stronger material had

not been available to replace cast iron in such details as driving wheel centers and foot plates. In cast steel we have a material which can be obtained with a minimum tensile strength to 90,000 pounds or more with a corresponding reduction in ductility. The best quality of cast steel for various locomotive details has not yet been fully determined, but in practice steel of nearly the lower limit of tensile strength appears to be preferred. It would be interesting to hear the opinion of steel makers on this point. Aside from the aim of saving weight, cast steel is used for many details in which cast iron had proved deficient in strength, such as the main wheel center of six and eight-wheel coupled freight engines, driving boxes and crossheads. Cast steel is also being widely used to replace expensive forgings, and it then permits greater latitude in design than is possible with forgings, and therefore secures a better job.

"It is interesting to note, however, that flanged and forged steel can be used in some cases to better advantage than cast steel, especially in boiler construction for dome rings, caps, etc. The advantage of cast steel is so well known that it may be profitable to mention some of the objections to its use. Cast steel has a greater shrinkage than iron, and is therefore more liable to strain in casting and consequent defects. Its rough finish, compared with cast iron, involves more expense in preparing the surfaces for the painter, and more imperfections for the latter to fill and cover up. The hardness and toughness of cast steel increase machine shop labor, and mean more tools for a given output. An important element to consider is the delay in locomotive manufacture and repairs caused by the extra time required to make steel castings as compared with iron, and the vexatious delays caused by castings which develop defects in machining. It is but fair to say that most of the above objections, though still serious, are being rapidly lessened by the great improvements in steel making and by the increase in capacity of the steel foundries.

A LOCOMOTIVE BOILER FLUE SWAGE.

The accompanying engraving illustrates the construction of a swage for preparing locomotive boiler flues for safe ending. It was devised by Mr. R. M. Galbraith, General Master Mechanic of the St. Louis Southwestern Railway, and is used in the shops at Pine Bluff, Ark. The flues to be safe ended



are heated at one end and entered into this block. The flue is then driven home, to the bottom of the block, by striking it upon an anvil. The swage block gives a perfectly round end to the flue and reduces its diameter to the proper amount when it is removed for use upon another flue. The engraving shows the dimensions and the form of the swage.

LIFE OF WOODEN BRIDGES.

In a discussion of the subject of wooden bridges at a recent meeting of the employees of the bridge and building department of the Chicago, Milwaukee and St. Paul Railway, Mr. E. S. Meloy said:

I have begun the compilation of the life of over 100 miles of wooden bridges of the class above mentioned, from which the following is extracted: The life of floors on pile bridges ranges between 7 and 11 years, the average being 9 years and 1 month. The percentage of renewals for the different ages are as follows: Renewed under 7 years, 3.1 per cent.; renewed in 7 years, 7.7 per cent.; renewed in 8 years, 14.9 per cent.; renewed in 9 years, 28.7 per cent.; renewed in 10 years, 31.6 per cent.; renewed in 11 years, 10.7 per cent.; renewed after 11 years, 3.3 per cent. Our Howe truss spans are subjected to much the same conditions that regulate the life of the pile bridges, and the average life of 281 spans, renewed during the past 9 years, is found to be 9 years and 6 months, being only 5 months greater average life than pile bridge floors.

Floors on iron bridges are subjected to fewer of the elements that tend to terminate the life of bridges than any other class, and the records of floors on 57 spans give an average life of 10 years and 2 months.

Concerning the life of wooden culverts, we have the records of over 6,000, which give an average of about 11 years. The greater portion of these culverts were built of new timber, but the policy now is to use only good second hand timber, and as our culverts built on this plan have all been constructed within 9 years, we cannot make a comparison between new and old timber.

In burning coke under steam boilers in order to overcome the smoke nuisance, many trials have been unsuccessful as regards economical working, and Mr. H. W. Spangler, writing in "Cassier's Magazine," tells some of the reasons. Coke being nearly pure carbon, requires a great deal more air per pound of fuel than coal does, and it also requires a deep bed of fuel, no fire being more difficult to restore to good condition after running low than a coke fire. There is little flame to coke, and the most valuable heating surface is directly over the fire. The heating surface in tubes may be smaller and the grate should be larger for coke than for coal. About two-thirds as much coke as coal may be burned per square foot of grate per hour in ordinary running, and from 30 to 40 per cent. of the grates should be open for the admission of air. It is also necessary to keep the plates over the fire cleaner than is required for coal burning.

"Aerial Rope Railways" was the subject of a paper read recently before the Liverpool Engineering Society by Mr. J. Walwyn White. It had special reference to the traffic between Liverpool and Manchester, and was reported by "The Engineer" as follows: "The system of carrying the loads in the air by means of aerial ropeways seemed to meet certain of the conditions. It did not interfere with ordinary street traffic, while it avoided all questions of compensation for severances, purchase of costly land, or building costly bridges. Only a small foundation was needed about every 300 ft., where supporting standards were placed, and he would use a separate rope for each span of roadway, thus evading some difficulties, and no rope was called to bear a greater strain than was due to the maximum load ever upon one span at a time. There were special advantages in the case of electric haulage. An automatic and effective absolute block system was provided, the passing load making its own electrical connections, and no load getting within a clear span of the load in front or behind it. The goods were to be loaded on a loose top on the horse lorry, and this with its load would be lifted and hooked on to the ropeway carrier. The ropeway could transport 6,000 tons per day at a working speed of five miles an hour. Branches could be taken off to supply intermediate towns. He would place a high signal tower every five miles and in telephonic communication with each other. He estimated the cost of thirty-five miles of double lines between the two cities, with complete outfit, at $1,800,000, and calculated a net profit of $300,000 a year, or sufficient to pay a dividend of 13½ per cent. on the cost, without reckoning some of the probable sources of profit he mentioned."

Electrical power transmission has been decided upon by the Russian Admiralty, for use in all warships, for raising ammunition, loading and working the guns and similar purposes.

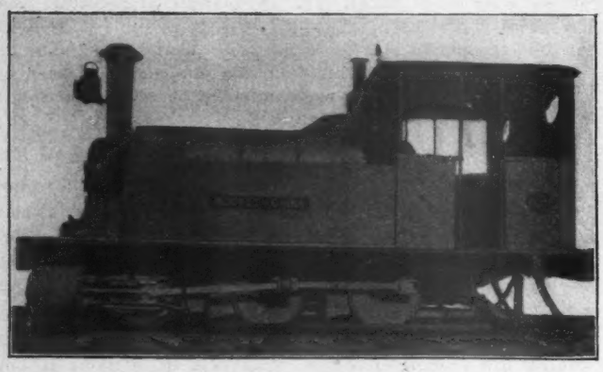
COMMUNICATIONS.

FIRST STANDARD GAGE LOCOMOTIVE IN CHINA.

Editor "American Engineer:"

The difficulties met with in the first introduction of the steam locomotives are not without their counterpart in China, and I believe your readers will be interested to know about the first Chinese locomotive.

The Chinese Engineering and Mining Co. had opened their coal mines at Kai-ping, eighty miles from Tientsin, with which it is now connected by rail. In those days there was no railway and the mines were eighteen miles from navigable waters. Moreover, a canal could only be carried to within seven miles of



The "Rocket of China."

the mines. After much delay and governmental expense permission was granted by H. I. H., the Son of Heaven, for the construction of a tramway from the mines to the head of the canal at Su-Ko-chung. This tramway was to be operated by mules, ponies and Chinamen. No permission for the use of a locomotive could be obtained, consequently as none could be ordered from abroad the chief engineer decided to build one without permission and then prove to the Chinese its superiority over mules, etc. The object was not to build a first-class locomotive, but to build, at as slight a cost as possible, a locomotive that would serve as an object lesson. The photograph shows the result.

The boiler was taken from an old English portable engine. The cylinders, 8 by 15½ inches, were from a winding engine. The driving wheels were of American chilled iron, 30 inches in diameter, and purchased as scrap. The frame and channel irons were taken from an old headgear of No. 1 shaft. The wheel base was 8 ft. 4 in.; the weight on drivers 6 tons. The engine had side tanks and end coal bunkers, one motion pump, one donkey pump and Stephenson's link motion. The cost completed for labor and other than old material was $540.

The locomotive was run for the first time on the centenary of the birth of George Stephenson, and very naturally was christened the "Rocket of China." On November 8, 1881, the first trip over the main line was made, a run of seven miles and return, with two coal cars full of delighted officials. After that she made 12,000 miles and is now a fixture in the railway shops, her only duty being to run a pump.

There is now in operation over 300 miles of railway, with some sixty modern locomotives, with thousands of miles of projected lines that will soon be under construction. All of the locomotives for the Peking-Tientsin line are American, by the Baldwin Locomotive Works. The photograph shows one of these fast passenger engines, with driving wheels seven feet in diameter. The photographs are of the same scale, and the two illustrate very correctly the progress made by China during the last few years.

ANDREI KMITA.

Peking, February 5, 1898.

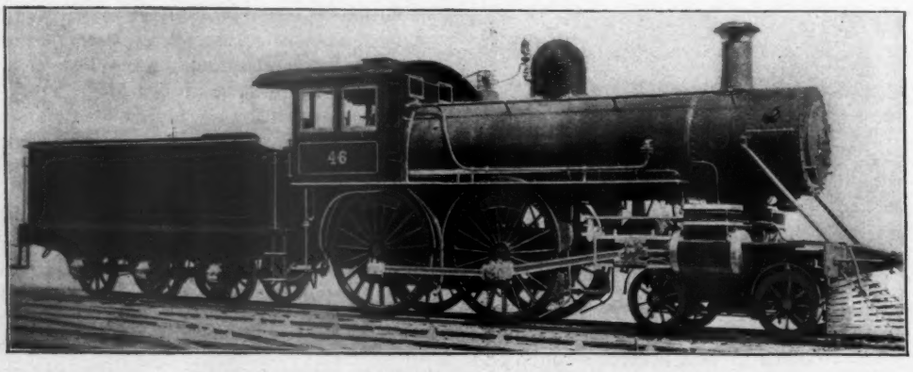
DRAFTSMEN FROM TECHNICAL SCHOOLS.

American Engineer:

Referring to your editorial inquiry in April issue for the reasons for the lack of good detail draftsmen, I submit that there are two principal reasons.

First, Insufficiency of technical school training. There is little justifiable excuse for this, as the schools are chiefly in industrial centers where it is easy to duplicate the conditions of actual drafting room service. Equipment is ample, even luxurious, but an essential thing very frequently lacking is a true ideal of service. The ideal draftsman is, like the mathematician, a man of fine scholarly attainments, satisfied with achievements in a field which cannot be popularly understood, nor have any part in common notoriety. It is the most quiet, elegant and brainy part of engineering. But our schools are on a basis of appeal to popularity. The ideals which they make most prominent are those of a prosperous contractor and the hustling man of affairs, a sort of advertising apotheosis of engineering which makes for padding and sciolism. These ideals, which are very persistently taught, are not productive of the mental qualities of a good draftsman.

Second, The absorption of much of the best drafting talent in selling and executive business. A draftsman may prepare designs which are the making of a successful factory, but after the patterns are completed his work as a designer in that connection is done. The clerk, a man of lower capabilities, is continually needed in the business, but the draftsman must either seek a new connection and slowly win the confidence of a new set of associates, only to repeat the experience again and again, or he must become a manager of manufactures or sales. As such he may have an excellent career, but the draftsman is lost.



Modern Baldwin Locomotive for Peking-Tientsin Line, China.

The ideal draftsman, then, who excels in his work and loves it for its own sake, must adhere to it with great singleness of purpose. He must oppose the ideals of the schools, and the temptations of business promising more in wealth and permanence. So when advertisers look for him he is found to be no longer in waiting, and they must content themselves with training to their requirements some young man who expects to use the drafting table as a stepping stone to the office desk.

CHARLES H. FITCH.

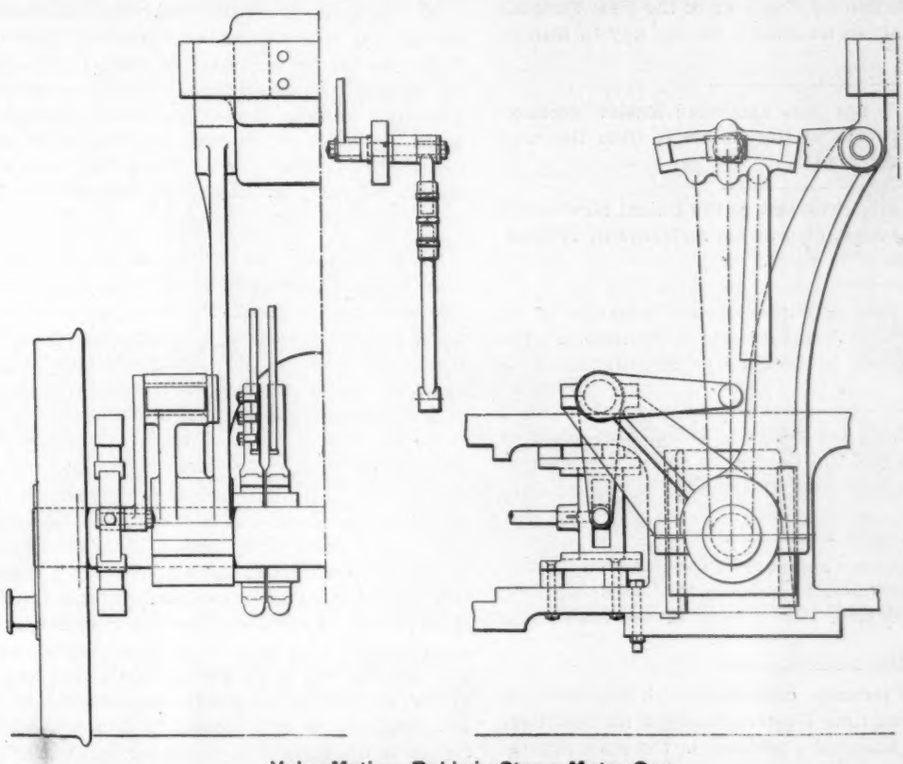
Chicago, Ill., May 29, 1898.

VALVE MOTION FOR STEAM MOTOR CAR—DETROIT & LIMA NORTHERN RAILWAY.

The interesting arrangement of the valve year of the steam motor car built by the Baldwin Locomotive Works for the Detroit & Lima Northern Railway, was mentioned in the description of that car in our April (1898) issue, page 135, and the construction of the gear is shown more fully by the accompanying engraving. The arrangement is patented. Its chief object was to bring the links up into the body of the car, rendering them accessible and protecting them from the dust. The shortness of the wheel base and the proximity of the axle to the ground made it specially desirable to protect the links, and it was considered important to use a modification of the ordinary Stevenson link motion.

The eccentrics are on the forward driving axle and work vertically like those of a marine engine, the links being horizontal. The axle carries a bearing from which an arm projects upward to a clamp on the boiler, through which its upper end passes with freedom for vertical motion, and a bar pivoted on this arm fixes the position of the link block. The motion of the link block is imparted by a rod and rock shaft to a slotted cross-head running on guides placed between the bars of the frame and from this the valve rod passes to the valve stem. The rock shaft is journaled in a second arm projecting from the bearing on the axle. The slotted cross-head allows vertical motion to take place between the axle and the frame without affecting the length of the valve connection. The links and the rock shaft bearings move vertically with the axles and the valve rods move with the frames to which the cylinders are attached.

The device is a simple one and it appears to fulfill its objects admirably.



Valve Motion—Baldwin Steam Motor Car.

WIDE RANGE OF COMPRESSED AIR.

There can be no more convincing commentary upon the wide range of applications of compressed air power than the sales report of the Clayton Air Compressor Works, Havemeyer Building, New York, for the months of February, March and April. In all, nineteen air compressors were sold for operating pneumatic stone tools, chipping and calking tools, air hoists, etc.; nine air compressors for moving and elevating acid and chemical solutions; four air lift pumping plants were installed and placed in operation; three air compressors were furnished to rubber works for removing hose from mandrels, testing hose and inflating tires; one compressor was supplied for the pneumatic transmission of messages; two for oil burning plants; three for racking off beer in breweries; one for spraying brick in the process of manufacture; and six for unusual applications of compressed air power. In addition to this number of air compressors furnished for domestic use, four were exported to Europe for operating pneumatic shop plants. Among the orders of especial interest included in the above summary may be mentioned the plant installed at the navy yard, Brooklyn, New York, for supplying pneumatic drills, paint machines and hammers, and one furnished to the Yarrow Ship Yard, London, for operating pneumatic tools. Another installation of interest is the compressor at the Dunn Building, New York, which supplies compressed air dusting nozzles for cleaning the iron grill work of the elevator shafts. Among the orders now in hand is a large compressor for the Bath Iron Works, Bath, Me., to operate pneumatic tools.

The rapid acceleration of trains is one of the advantages sought in the application of electric traction to suburban lines of railroads. Rapidity in starting and fair maximum speed will increase the average speed for service that requires frequent stops, far beyond that possible with high maximum speed and low acceleration. It is reported that the schedule proposed for the Chicago suburban lines of the Illinois Central contemplates an acceleration of 40 miles per hour in 20 seconds after starting and it is understood that the electrical companies are figuring on this basis. Such a rate of acceleration would be almost ideal from the standpoint of the passenger, but there are other considerations, such as the size of the motors and the load line at the power house, that prompt the question whether it is not possible to go too far, or too fast, even in such an important improvement as this. The motors for rapid acceleration must be large and the load on the generators heavy at starting and almost nil afterwards, and this comprises a very expensive distribution of power, that would only be economical with an enormous number of train units, a condition that does not exist on such railroads. Good engineering and good business management would seem to recommend more moderate acceleration and better conditions for economical operation. The experience of the Metropolitan Elevated in Chicago points to the advisability of using moderate acceleration.

PERSONALS.

Mr. Warren G. Purdy has been elected President of the Chicago, Rock Island & Pacific.

Mr. J. R. Slack has been appointed Mechanical Engineer of the Central Railroad of New Jersey.

Mr. J. C. Whitridge, Associate Editor of the Railroad Gazette, has received the degree of Mechanical Engineer from Purdue University.

Mr. Herbert Roberts has been appointed Superintendent of Motive Power of the Norfolk & Southern, succeeding Mr. G. R. Joughins.

Albert P. Massey, Mechanical Engineer of the New York Air Brake Company, died at sea on June 5, on the way to Europe, at the age of 56 years.

Mr. J. J. Thomas, Jr., has been appointed Master Mechanic of the Montgomery Division of the Mobile & Ohio Railroad, with office at Tuscaloosa, Ala.

Gen. Robert J. Stockton, President of the United New Jersey Railroad & Canal companies, died at his residence in Trenton, N. J., May 5, at the age of 66 years.

Mr. G. W. Seidl has been appointed Master Mechanic of the Baltimore & Lehigh, with headquarters at Baltimore. The office of General Foreman of Locomotive Repairs has been abolished.

Mr. James M. Naughton has resigned as Superintendent of Motive Power of the Wisconsin Central to accept the position of Superintendent of the Brooks Locomotive Works at Dunkirk, N. Y.

Mr. J. W. Marden has been appointed Superintendent of Motive Power of the Fitchburg, to succeed Mr. John Medway. Mr. Marden has been Master Car Builder of the road for a number of years.

Mr. J. W. Gardner, recently connected with the Sterling Boiler Co., and for a long time Western Manager for Manning, Maxwell & Moore, has accepted a position in the sales department of the Sargent Co.

Mr. George Westinghouse has been elected an honorary member by the German Society of Locomotive Engineers, which has about 14,000 members, "as a recognition of his services to transportation by the invention of his railroad brake."

Mr. E. S. Marshall, formerly manager of the Railway Department of the Missouri Malleable Iron Co., has resigned to become general sales agent of the Missouri Car & Foundry Co., with office at St. Louis.

Professor H. Wade Hibbard, who has for several years been at the head of the railway mechanical engineering department of the University of Minnesota, has recently been appointed principal of the new Graduate School of Railway Mechanical Engineering of Cornell University, Ithaca, N. Y.

Timothy Case, formerly General Superintendent of the Green Bay, Winona & St. Paul, died suddenly in Chicago, May 9. He was born in Middlebury, Vt., in 1823, and began his railway career in 1849 as foreman for the contractors constructing the Hamburg tunnel on the Hudson River Railroad. Since March, 1885, he has lived in Chicago

Mr. Boone V. H. Johnson has been appointed Assistant Engineer of the Safety Car Heating and Lighting Company, at St. Louis, in place of Mr. W. H. Hooper, promoted to the position of General Agent of the same company at Chicago. Mr. Johnson was formerly with the Pullman Company, and recently with the New York, New Haven & Hartford Railroad Company, at New Haven, Conn.

Mr. R. F. Hoffman, who has for the past year held the position of Mechanical Editor of the "Railway and Engineering Review," has recently resigned to engage in special mechanical engineering work in the motive power department of the Atchison, Topeka & Santa Fe Ry. His many friends will join us in wishing him success in his new position. Mr. Hoffman's attention will be concentrated on the use of locomotive fuel.

Mr. Edward L. Coster has been appointed Assistant in Mechanical Engineering at Columbia University, New York City. He has for a number of years been a careful student of mechanical railway subjects, and is an honorary member of the American Railway Master Mechanics' Association, and an associate member of the American Society of Mechanical Engineers. He will have direct charge of the new Columbia locomotive testing plant during its construction and afterward.

Mr. E. G. Allen, for the past five years General Superintendent of the Old Colony system of the New York, New Haven & Hartford, has resigned. Mr. Allen has been in railroad service for 33 years. In 1891 he was made Superintendent of the Central Division of the Old Colony Railroad and when that road was absorbed by the New York, New Haven & Hartford in 1893 he was appointed General Superintendent of the Old Colony Division.

Mr. G. R. Joughins, heretofore Superintendent of Motive Power of the Norfolk & Southern, has been appointed to succeed Mr. Francis R. F. Brown as Mechanical Superintendent of the Intercolonial of Canada, recently resigned. Mr. Brown was born and educated in England, and began railroad work there in 1863, on the Great Northern Railway. He has had an exceptionally wide and successful experience in England, India and Canada, and is an accomplished civil and mechanical engineer as well as locomotive superintendent. His successor, Mr. Joughins, is well known in this country, especially with regard to his designs in metal car and truck construction.

Dr. Charles E. Emery, one of the foremost and best known American Mechanical Engineers, died in Brooklyn, N. Y., June 1. He was born in Aurora, N. Y., in 1838, and was educated in that State, showing a tendency toward engineering pursuits when very young. He had some experience in a railroad drafting room, and in a country foundry and machine shop, and also studied law. In 1861 he entered the navy as Assistant Engineer on the steamer "Richmond," and remained in the service in sea or experimental work until 1869. He was afterward consulting engineer to the U. S. Coast Survey, and did a great deal of original test work on steam engineering subjects. His greatest work was the design and construction of the plant of the New York Steam Co., of which he was Chief Engineer and later General Manager. For the past 10 years he has been engaged in general consulting work, and his services have been in great demand. He was prominent in the engineering societies and was awarded the Watt medal and Telford premium by the Institution of Civil Engineers (England). He was a highly accomplished engineer, a keen observer, a thorough student and ready speaker, especially on engineering subjects. His delightfully courteous way of speaking of and to those who disagreed with his views was a characteristic that struck many who did not have the benefit of a personal acquaintance.

TWO NEW MACHINES—THE NILES TOOL WORKS.

The two machines shown in these engravings are new productions of the Niles Tool Works Co., Hamilton, Ohio.

The first is a duplex horizontal milling machine, built for heavy work, and is powerfully driven and geared, the cone driving pulleys having wide faces for large belts. The bed of the machine has two wings, upon which the uprights are seated. The uprights may be adjusted laterally without disturbing their alignment, thus providing for a wide range of work. As the wings are cast in one piece with the bed, the adjustment of the uprights does not affect their rigidity. The spindles are large and hollow and run in bronze bushings, provision being made for taking up end thrust and wear. The spindle heads present large square surfaces to the uprights, and are, as is also the table, square gibbed. Both uprights and bed are extremely heavy, well proportioned and heavily ribbed, and the metal is distributed to withstand the strains due to heavy cuts. The shafts and gears are of ample proportions, and all gears are cut from the solid. The table has power feed and power quick return. All handles for controlling the movements and feeds of the machine are placed within convenient reach of the operator, thus enabling him to watch his work, while using the handles for throwing in or reversing the feeds or for stopping or starting the spindles. The lubricant used in cutting is collected in suitable troughs and led to a reservoir in the bed.

The second, known as the "No. 6 Vertical Milling Machine," is specially intended for use in railroad shops for milling links and general profiling work, the appearance of the machine being clearly shown in the engraving. The spindle is driven direct by belt for fast speeds and by back gears for heavy work. The maximum distance from the table to the end of the spindle is 26 in., the distance from center of spindle to column 24 in., the diameter of the circular table 42 in., longitudinal traverse of table 20 in., and the transverse traverse of table 32 in. The driving cone pulley has four steps for a 4½-in. double belt and cross; longitudinal and circular feeds are provided, arranged so as to be operated from the front or side of the machine. The facilities for profiling work are excellent, owing to the longitudinal, cross and circular feeds of the circular table, which may be operated by power or by hand.

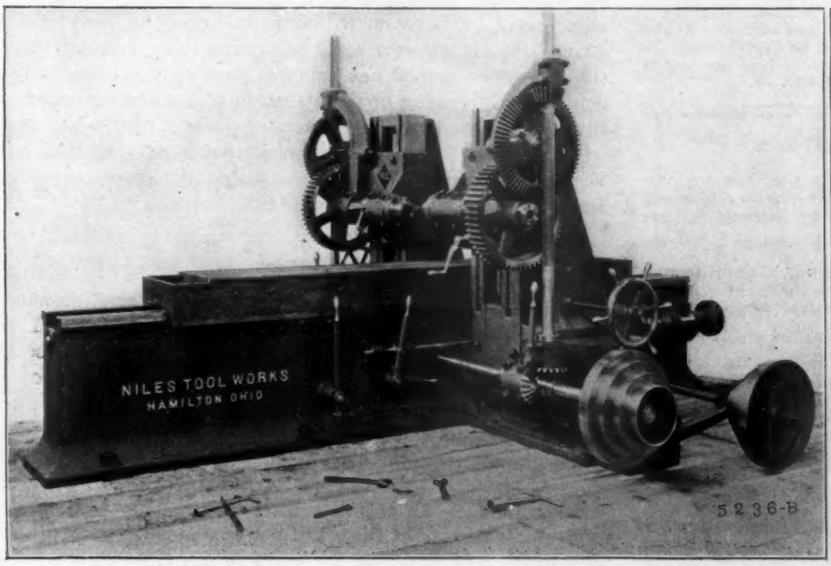


Fig. 1.—Duplex Horizontal Milling Machine.

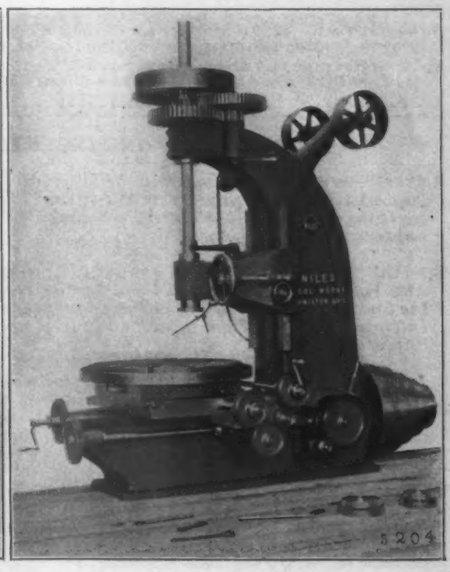


Fig. 2.—Vertical Milling Machine.

THE NILES TOOL WORKS, HAMILTON, OHIO.

AIR MOTORS—METROPOLITAN STREET RAILWAY, NEW YORK.

The Metropolitan Street Railway Company has made a contract with the American Air Power Company for the equipment of the Twenty-eighth and Twenty-ninth street line, New York city, with the Hoadley-Knight air motor. The contract is for the complete equipment, including twenty cars, which will be of the same type and external appearance as the Broadway cars. A new power house will be built on the property of the Metropolitan Company in West Twenty-third street, opposite the Pennsylvania terminal. The air compressor for which order has been placed is of 1,000 horse-power capacity, and is of the Ingersoll-Sergeant Four-Stage Single-Acting type, provided with intercoolers between each pair of cylinders, and a final cooler after the fourth stage cylinder. The air cylinders are to vertical, and will be set underneath the engine, which is a vertical cross-compound condensing Reynolds' Corliss engine, built by the E. P. Allis Company. Air will be compressed to a suitable pressure and will charge the cylinders or bottles used in the cars.

The American Air Power Company, which was formed by the combination of the Hoadley-Knight and Hardie Companies, has a capital of $7,000,000. Its relations with the Metropolitan Company have been very intimate, and for several months past part of the power-house at 146th street and Lenox avenue has been used by the Air Power Company for experimental work. Several cars have been equipped with air motors there, and have been successfully run over the Lenox avenue line.

A handsome furniture car made by the Northern Pacific Railway Company at its shops in South Tacoma, Wash., will soon go forward and be placed on exhibition in Omaha. It is a fine advertisement of western coast lumber. It is forty-two feet in length, with a capacity of 70,000 pounds. It is finished in oil, and is built of fir, cedar, and spruce, with a little oak used in the door-frames.

Thirty new consolidation freight locomotives have been ordered during the past week by the Baltimore & Ohio Railroad, and the order has been divided as follows: The Baldwin Locomotive Works, fifteen with 21 by 26 inch cylinders, and five with 22 by 28 inch cylinders; the Pittsburg Locomotive Works, ten with 22 by 28 inch cylinders; the large engines are for use on the mountain divisions while the others are of the same class that are being used between Cumberland and Baltimore.

(Established 1832.)

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One of the committee reports before the recent convention of the Master Mechanics' Association is a model in construction and execution. It is unique and presents an idea worth copying in committee work in general. The report itself was prepared by the whole committee, and signed by all of the members. Then each member made a study of some special branch of the subject and considered it in some one of its bearings upon other things, and these are given in the form of appendices, not less valuable than the report itself. We refer to the report on higher steam pressures.

Three subjects of the many taken up at the recent convention of the Master Car Builders' Association stand out prominently as those from which important results may be expected. They are the recommendation of specifications for automatic couplers, and the allowable limits of wear in service, the subjection of all types of triple valves for air brake apparatus to tests by the committee having this matter in charge, and the disposition of the request for an adjustment of the prices paid for labor and material in the repair of freight cars west of the 105th meridian. Satisfactory reports upon these matters will constitute a successful year in the history of the association.

When we say that steel cars, one of the most important subjects before the Master Car Builders' Association, was not properly treated at the recent convention, we voice the opinions of a great many influential mechanical railroad officers, and it is to be regretted that another year has passed with so little light thrown upon the steel car problem. There was practically no discussion of the report at the proper time, yet there was a great deal of it outside of the convention, and particularly during the Master Mechanics' convention. Is the Master Car Builders' Association shirking a difficult but most important task?

Last year four designs for steel cars were submitted to the association by individual members, and at Saratoga it was expected that much interest would be shown in them and in the widely different principles of construction which they embodied. Since that time several other designs have appeared, and practical tests in service have been made with large capacity steel cars, and not a word said about them in the discussion except to direct attention to the need for heavier draft gear. During the year steel cars have been wrecked; surely the experience gained was valuable, and there is apparently no subject more worthy of the attention of a standing committee than this, even if the work done is merely historical. Many will doubtless join us in believing that a mistake was made in not appointing a committee to watch and report experience and progress in this most important matter.

Some of the most valuable of the deliberations of a technical organization are those which are arranged for brief consideration, with a prearranged limit to the time to be occupied, and when the subjects are well introduced the result may be not less important than is obtained from elaborate papers or reports. To get the most out of them, however, the subjects need careful selection, and the conduct of the discussion should be such as to insure the briefest and "meatiest" presentation of ideas. When such discussions are intended to bring out the relative importance of the subjects treated, with a view of selection of certain of them for more extended treatment, that plan which will bring out the views of the greatest number of participants should be carefully followed, and exhaustive treatment of the questions should be as carefully avoided.

The apprentice problem has been considered a difficult one, and it was the subject of very earnest painstaking work by the Master Mechanics' Association, the efforts being directed chiefly toward the arrangement of plans for courses through the shops. These are good and necessary as far as they go, but whether an apprentice has or has not the advantage of technical education there is a more important factor than the systematic arrangement of his work. It is of first importance that the officers should interest themselves in the boys, their welfare and instruction. The ideal of education as expressed by Prof. Goss, in the discussion on technical education, before the association (printed elsewhere in this issue), which was elaborated in his admirable lecture, to which we also refer, may be applied equally well in shop practice. The underlying idea in this is to "draw out and make larger men." If this principle inspires the officers when they engage apprentices the question of establishing courses of work solves itself. The courses without the deep interest in the apprentices will fail as they have often failed. We want everyone to read what Prof. Goss said about the technical school training and the spontaneous and extemporaneous statement of the correct view of such education indicates Prof. Goss to be one to whom the guidance of young men may be safely and confidently intrusted. Mechanical railroad officers, inspired by the same idea in regard to shop education, will have no "Apprentice Problem."

BOILER AND STEAM PIPE LAGGING.

Under the title "Best Methods of Boiler and Cylinder Insulation," a committee of the Master Mechanics' Association has presented a report showing that the practice of protecting boilers and cylinders with something else than wooden lagging is increasing, and also showing that the cost of applying good non-conducting materials to boilers and cylinders may be saved in fuel in a single year. The best kinds of lagging will last a long time, and will continue to pay interest on the investment.

Almost simultaneously with the report of this committee comes a most valuable paper before the American Society of Mechanical Engineers upon the same general subject, by Mr. C. L. Norton, of Boston. By this author also it is made clear that the money spent in good laggings is well invested, and the fact is brought out again that magnesia coverings are very near the top of the scale. In the case of the master mechanics' test they are at the top, all of which bears out the position taken previously in these pages.

One very important point seems not to have received the attention that it merits, viz., the lagging of the saddles as well as the cylinders and the boilers of locomotives. This is not mentioned in the committee report referred to, and we think it worth while to call attention to the saddles as being important candidates for the best-known lagging. It is not sufficient to protect the boiler and the cylinder, because some of the steam may become water by condensation on its way between the two. There is no doubt that water in a cylinder not only plays havoc with economical working, but it reduces the power of the engine, and this interferes with economy in the worst possible way. The boiler, the cylinders, the feed and the air pump steam pipes, the cylinder heads and steam chests, and the saddle castings, all ought to be lagged. The saddles are in a very exposed position, and they present such a large radiating surface as to compel attention as a great source of loss of heat, particularly in cold weather. This heat costs as much in fuel burned as any that is produced in the boiler, and we think it costs more than that lost through direct radiation from the boiler itself because of the harmful influence of the water of condensation in the cylinders.

These reports have attracted our attention anew to the relative merits of different kinds of protective coverings, showing that asbestos does not occupy as high a place in the scale as many have appeared to give it. Neither of them has said enough about the fact that physical as well as heat resisting qualities are important in lagging. The covering must not mat or solidify in service to such an extent as to lose its ability to support the jacket and allow it to become buckled or indented. The lagging must be free from injurious chemicals to act on the jacket and corrode it, and also pit the boiler shell. It is important that air spaces should not be left in the covering in such a way as to provide channels for air currents to carry away heat from between the parts of the covering. The question of the best lagging is not by any means settled when the best non-conductor of heat is discovered and that covering is best which is at the same time a poor conductor of heat, a durable close-fitting jacket and a removable coat which may be replaced repeatedly when the engine goes through the shops for repairs. There are such coverings, and they were tested by Mr. Norton and by the committee.

NOTES.

The effect of the length of steam pipes on the economical working of engines was illustrated in a paper by Sir John Durston, Engineer in Chief of the English Navy at the recent meeting of the Institution of Naval Architects, in which it was said that the trials of the "Diadem" showed a saving of from 20 to 30 per cent. of the total coal used by the use of the after boilers, which were those having the shortest steam pipe.

An air motor car on the Hardie plan is to have a trial on the street railroads of Copenhagen, Denmark, the machinery having been built in the United States. The car has two decks seating 48 people. It will weigh 26,000 lbs.

A record of 580 knots in one day was made by the North German Lloyd steamer "Kaiser Wilhelm der Grosse" on her most recent voyage from Bremen to New York. This is the greatest day's run ever made, the best previous record being 566 knots.

The Westinghouse Air Brake Co. has just closed a contract to furnish between $2,000,000 and $3,000,000 worth of air brakes to the Manchurian Railway in Russia. This will necessitate the making of these brakes in Russia, and it will probably lead to the adoption of the apparatus on other European railroads.

The railway postal car is finding its way into South America, six cars having been ordered from a Springfield, Mass., firm for shipment to Brazil. While they are to be patterned as much as possible after our own style, they are to be finished in mahogany. The dimensions, of course, will fit the five-foot gauge of Brazil.

Hydrogen has been liquified by Professor Dewar, who has long been studying and experimenting upon the subject. The work was done in England at the Royal Institution, where equipment for experimenting with low temperatures has been installed. On May 10 Professor Dewar announced that he had succeeded in liquefying both hydrogen and helium.

The low cost of steam power at the plant of the Warren Manufacturing Company at Warren, R. I., for a year of 300 10-hour days ending last Fall was $11.55 per horse-power, including the cost of fuel, wages, supplies, interest and taxes. The engines are vertical cross compound Reynolds-Corliss type built by the E. P. Allis Company of Milwaukee, Wis., and we are informed by the "Engineering Record" that a recent test showed a steam consumption of but 12.44 lbs. per horse-power hour when developing 1,836 horse-power.

A new inertia indicator was explained by Mr. Wilfred Lewis at a recent meeting of the Engineers' Club of Philadelphia. After explaining the difficulties of measuring the inertia of moving machinery by older methods, he exhibited and described an instrument which he had devised for this purpose, which consists essentially of a curved tube filled with water, except for a small bubble of air which moves back and forward in the tube with its acceleration and retardation, caused by the inertia of the body which carries the instrument. By means of a graduated scale placed beside the tube, the inertia may be measured.

Coal Statistics of Pennsylvania for 1897. The following statistics have been compiled by Mines and Minerals, Scranton, Pa., from data furnished to that journal by the State Bureau of Mines and the State Mine Inspectors. The figures are reliable and official, and, as practically all of the anthracite product of the United States comes from Pennsylvania, these statistics give the complete anthracite production for the year 1897:

	Anthracite. (Long tons.)	Bituminous. (Short-tons.
Tons of coal mined	46,947,354	54,674,452
Tons of coke made	....	8,533,291
Persons employed	149,557	88,554
Coal mined per employe	314	617
Coal mined per miner	490	744
Fatal accidents	424	149
Non-fatal accidents	1,106	426
Life lost per 1,000 employees	2.83	1.68
Accidents per 1,000 employees	7.39	4.81
Production per life lost	110,725	366,942
Production per non-fatal accidents	42,448	128,344

Compared with the year 1896, these statistics show a decrease in the production of anthracite coal of over a million tons, while the output of bituminous has increased nearly four and one-half millions of tons and the output of coke nearly two millions of tons.

PNEUMATIC TOOLS—THE CHICAGO PNEUMATIC TOOL COMPANY.

The exhibit of the Chicago Pneumatic Tool Company at the Master Car Builders and Master Mechanics' Conventions at Saratoga embodied the latest and most useful improvements in the application of pneumatic power to shop tools. The great interest which was shown in the exhibit was sufficient evidence of the effect of pneumatic shop tools in railroad work. It attracted by far the greatest amount of attention from the railroad men and manufacturers, and was crowded with interested people every day. Several new and exceedingly valuable additions to the tools manufactured and sold by this company have been made since last year, and in a general way our engravings show their variety and the character of the work which they do. One of the engravings shows a general exterior view of the exhibit, the Rand air compressor and storage reservoir being seen at the right in the background, while the other view gives an idea of the machines themselves. As we shall illustrate and describe many of these in detail, a general summary only will be given here, which will serve to direct attention to the progress that has been made.

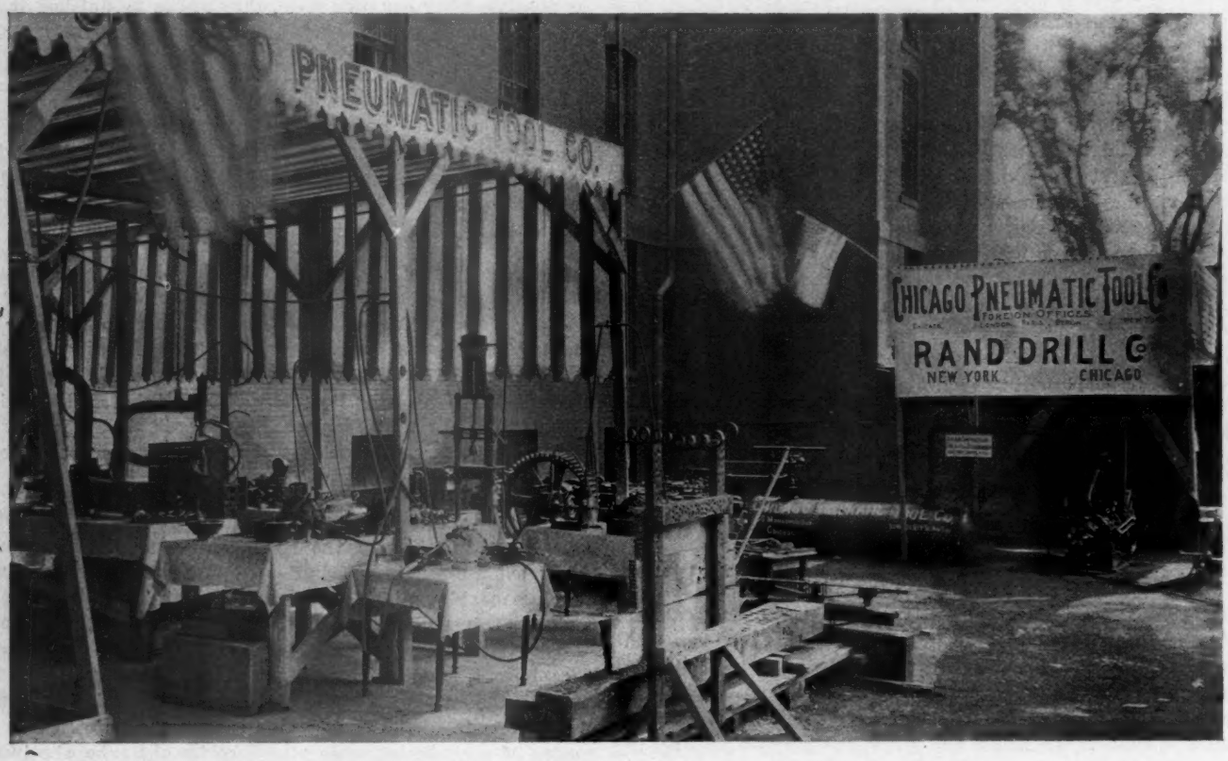


Fig. 1.—Exhibit of the Chicago Pneumatic Tool Co., at Saratoga Conventions.

Work of Wood Boring Tools is shown at center of this engraving.

The pneumatic hammers of this concern were the best known of all of their machines, and several sizes for chipping, caulking, flue beading and riveting were shown in operation. The power for chipping was well illustrated by the chipping of a 7-16 inch steel boiler plate in the center of the exhibit, the results of which are shown in the engravings.

Piston air drills of the Boyer three cylinder type were shown, and the application of a new breast drill weighing but 7½ pounds to the boring of wood was interesting. This machine bores holes up to one inch in diameter in wood and to ⅜ of an inch in iron. The Whitelaw two piston air drill has an aluminum frame, and one weighing but 8½ pounds bores holes up to 3 inches in diameter in wood and 1¼ inches in iron. The Whitelaw single piston oscillating cylinder breast drill, weighing but 6 pounds and drilling holes up to ⅜ of an inch in iron, is used for drilling the test holes in staybolts. It has a brass frame and is a compact, handy little machine.

The manufacture of car and locomotive jacks for use in yards and shops is a new departure by this company. The exhibit contained one 12 inches in diameter, with a 22-inch lift, having a capacity of 5 tons. Different sizes are made, and the construction is such as to give the greatest possible lift. The cylinder is cast, and the heads held with cap screws, the piston having leather packing. A small two-wheel truck is made to carry the jack by means of trunnions cast on the cylinder. The valve is attached to the top head. Among the new tools is a lathe head, with its spindle driven by a Boyer motor. This head takes Morse taper shanks for chucks, face plates or buffing wheels, and the machine is convenient for many purposes.

A vertical drill, with two solid and one hollow uprights, is also a convenient tool; it is shown in the background at the right in Fig. 2. The drill spindle is extended upward and is driven by a Boyer motor directly connected. The crosshead carrying the lower end of the spindle is counterweighted by a weight running in the hollow support of the machine, consisting of a 3-inch pipe. The work table may be raised or lowered by gears and clamped in any desired position.

At the left of the drill press, in Fig. 2, is a McIntosh improved flue welder, adapted to swage, open and weld tubes of 2, 2¼ and 2½ inches diameter. The hammer of the machine is driven on its downward stroke by air pressure and returned by a spring.

This company now manufactures a light, convenient pneumatic painting machine, which we should say would hold about 1½ gallons. It is intended for painting or whitewashing, and is held in one hand while operating. The Boyer speed recorder is too well known to require description. One was rigged to be run by a Boyer motor, to show its operation.

The heavy pneumatic hammers used as riveters have made wonderful progress in bridge and shipbuilding work. The yokes are of light sections, sometimes of 3½-inch pipe, and sometimes of light trussed angle construction. The frames have gaps of from 15 to 84 inches, and rivets up to 1 and 1½ inches

are closed rapidly and satisfactorily. Sectioned samples of riveting showed the work to be excellent, and superior to a great deal of hydraulic riveting that we have seen.

Our readers are familiar with the Manning sand-papering machine, which is one of the earlier applications of air motors to wood work. If they are not equally familiar with the new flue cutter and roller they should take the earliest opportunity to see it in operation. The motor of this machine gives 3½ horse power, and it may be used in many kinds of work, being portable and convenient to operate. One of these machines was belted to an Ajax forging machine of a capacity of 2½ inch bars of iron or steel. The motor seemed ridiculously small to be running the massive forging machine, but it was doing it easily.

The Whitelaw staybolt cutter or "biter" is new and is a money saver in cutting off the ends of staybolts. The capacity of the present machine is 1⅛ inches, but another, nearly ready, will cut 1½-inch material. The list of devices was completed by a Curtis cylinder 1,500-pound air hoist, with a lift of 4 feet. The capacity and lift may be made to suit requirements, and all sizes are fitted with check valves to hold the load if the hose bursts. These hoists have equalization pipes to prevent drawing air with dust from the shop into the cylinder.

Power to run these tools was furnished by a 10x14-inch straight line Rand compressor mounted on two 8x8-inch timbers set in the ground in lieu of a foundation. An automatic unloading device regulates the operation of the compressor to suit the consumption of air. The volume of the cylindrical storage reservoir used in this case was about 30 cubic feet.

The more interesting and novel of these machines will be illustrated in a later issue.

Fig. 2—Exhibit of the Chicago Pneumatic Tool Co., at Saratoga Conventions.

Work of the Chipping Hammers on $\frac{7}{16}$-in. Boiler Plate is shown at the center of this engraving.

REGULATION OF COMPOUND WOUND DYNAMOS.

A very important and far-reaching decision has just been handed down by the United States Circuit Court of the Northern District of New York in what is known as the "Compound Wound Dynamo Suit," constituting a great victory for the Siemens & Halske Electric Company of America, the defendants. The suit was brought by the Edison Electric Light Company against the E. G. Bernard Company and others, and was instituted by the General Electric Company, and defended by Messrs. Siemens & Halske. The basis of the suit was Thomas A. Edison's patent No. 264,668, for an improvement in regulating the generative capacity of dynamos, and the basis of the defense was Brush's invention and patent preceding Edison's work on commercial machines, and which, as stated in the opinion of the court, anticipated the patent granted to Edison.

The importance of this decision is very great, and concerns all manufacturers of dynamo-electric machinery, and it is stated by interested persons that had the suit been decided in favor of the General Electric Company it would have subordinated nearly all of the electric railway generators and also the direct lighting work in this country. The opinion is much too long for us to reproduce. Edison's specification says:

> The object of this invention is to produce means by which the addition or removal of translating devices in the multiple-arc circuits of a system of electrical distribution shall cause immediately a proper regulation of the current energizing the field magnet of the dynamo-electric machine supplying such system, and this without the use of adjustable resistances, or of any mechanism whatever, except the ordinary circuit controllers of the lamps.

The opinion shows that the earliest date assigned for the conception of the Edison patent was August 19, 1879, and the date of Brush's patent was July 22 of the same year. Edison's machines made at the time of his patent did not operate satisfactorily and never were commercially successful. The defense was lack of novelty and invention, and non-infringement and the lack of novelty was based on the Brush patent just referred to. The court says:

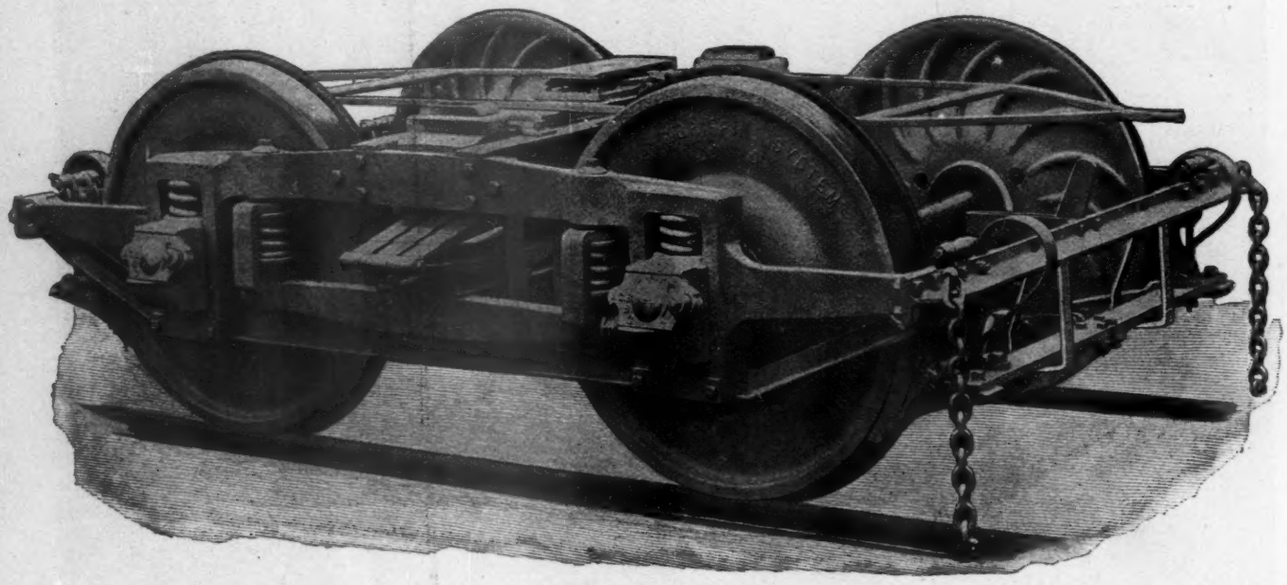
"The proof shows that a number of machines were built pursuant to its (the Brush patent) directions, and were commercially used more than two years prior to the date of the application for the Edison patent. These machines exist at the present day, and what is quite remarkable and almost unique in patent litigation is the fact that in an art which has progressed with giant strides, machines made nearly twenty years ago are not only operative, but practically as successful as when first built. Two of these working dynamos have been introduced in evidence, one by the complainant and one by the defendants. Each is capable of doing the same work now as in 1880."

The bill was dismissed, and the defendants are to be congratulated on the result of the suit.

Mr. R. H. Soule will represent the Baldwin Locomotive Works at Chicago after July 1, and Mr. C. A. Thompson of St. Louis will act as Southwestern representative.

A PASSENGER LOCOMOTIVE TRUCK—THE J. G. BRILL COMPANY.

An experiment in electrical railroad work is being tried in France which in many respects is more like Yankee than French engineering. The idea is to construct an electric passenger locomotive which shall not only haul a train, but shall carry passengers as well. It is to be carried out upon a scale and in a manner which has never been attempted in this country, an ordinary electric car hauling a trailer is the limit of American work in this line. The French proposition is to build a moderate-sized double truck passenger coach weighing complete 96,000 pounds, and provide it with sufficient motive power to utilize the adhesion obtained by this weight. The line is some 200 miles in length, and express speed is to be maintained. The car body for this machine was built in France, and only a few details are at hand in regard to it. The floor frame is of channel bars. It is 36 feet 9 inches long and 6 feet 9 inches wide. The channels are apparently about 10 inches deep. No details whatever are given in regard to the body, which is carried by a pair of "Perfect" trucks (The J. G. Brill Company's No. 27) of the type especially designed to meet the requirements of steam passenger cars. These trucks are quite as great a departure from the common order as the scheme for the car itself. One of them is shown in the illustration.



Brill Truck for Electric Passenger Locomotive.

The trucks must perform all the essential work of a locomotive. Their second function is that of a railway carriage. The car and the machinery must be carried without shocks or disturbance, curves must be passed smoothly and without danger, and the load must not exert a destructive action upon the roadbed.

To meet the requirements of the locomotive alone the trucks are built in the most substantial manner. The side frames, which also form the jaws for the journal boxes, are heavy forgings nearly as large as the bars of a locomotive frame. They are deeper, but not as thick. The end pieces of the frame are T irons, carried by palms worked upon the side pieces. The seats in these palms are finished and the holes are reamed for taper bolts. Locomotive practice is followed in constructing the trucks, and wherever bolts are used they are made taper, and the holes are reamed. The swing bolster is held between a pair of angle iron transoms, which are bolted to the side frames of the truck. The ends of the angle are cut out and bent so as to form brackets for the purpose. The wheels are of unusual size, being 45 inches in diameter. They are of cast iron, and are mounted upon very large axles. These are 7 feet 6 inches long, and 5 inches in diameter at the wheel fit. The journals are 4¼ by 8 inches. Each truck is furnished with a pair of 150 horse power motors, thus giving the car 600 horse power. The trucks weigh 11,080 pounds each. The motors 10,000 pounds per pair, and the car body 24,000 pounds. This brings the weight without passengers up to a little more than 66,000 pounds. Lead or iron ballast will be used to get the required load of 96,000 pounds.

An entirely new departure has been made in the locomotive truck for the French car. Ease of riding was considered of the utmost importance, and it was determined to make it ride as smoothly as a carriage should, while at the same time it possessed all the necessary features of strength, stiffness and durability. In the production of an easy riding carriage the initial step was the introduction of journal springs over the boxes. The first advantage of this is the reduction of the weight not carried by springs, which now consists of wheels, axles and boxes only. The heavy equalizer, instead of resting directly on the boxes, is carried by the open links, in which another set of springs are introduced. The latter have the same capacity as those on the journal boxes, and have a double function, cushioning the equalizing movement where the wheel rises, and cushioning the swing motion when the truck moves sidewise. The equalizing bar forms a part of the swing motion, and is firmly attached at its center to the spring plank. The links by which it is carried are attached to the wheel piece a short distance from the centers of the journal boxes. The hanging of these links consists of a large bar carrying a spring seat upon the lower end, while the upper post terminates in a square head, under which a ball or hemisphere is finished, forming, with a hemispherical cup in the solid frame, a ball and socket joint. The hole beneath is made sufficiently large to allow the bar the required swing. This construction gives an extra link, as no room is taken up by the hinge. Upon the spring plank there are two sets of triple elliptic springs. Quadruple springs would have been preferable, but in this case the contract limited the wheel base to 6 feet, and there was only room for the triple springs.

The steadiness of these trucks under the action of the brakes is a valuable feature. On account of the changed relationships between the bearing points and the suspensions of the equalizers at the ends, with the weight actually central, these trucks do not tilt under the action of the brakes, no matter how hard they may be applied.

As shown in the engraving, this truck is substantially the form of "Perfect" truck which the Brill Company recommend for steam passenger service. It is fitted with the M. C.

B. standard box, and in other respects would conform to the standard. The brake rigging is nearly the same as that used on heavy steam car work. The brake beam in this case is a heavy flat bar trussed for strength, but the brake hangers, springs, straps, etc., are like those used on steam road trucks. It should be noted that the double brake rod shown in the cut is a feature introduced for the purpose of clearing the motors, which come up very high. The brake levers could not be inclined because the French guard rails are high and fill the whole space between the rails, except a small opening in the center, which was the only place for the lower rod. By using pipe the double rod was made quite light.

SUSPENDED VS. SUPPORTED JOINTS.

The following paragraphs are reproduced from a communication from Mr. C. P. Sandberg to "Engineering":

It is now about 30 years ago since the suspended rail-joint was introduced. During these 30 years I have done my share to improve the suspended rail-joint by adopting angular and deep fishplates, so as to give the rail-joint the same stiffness as the solid rail. Since then it has been found that the supports were to be more relied upon to keep the joints up than any design of fishplates, so the joint sleepers have been brought together more and more, now only leaving the space absolutely necessary for packing. Thus I have arrived at the so-called Goliath joint. This was applied to my 100-lb. rail, which has now been seven years in service in St. Clair's tunnel, Canada, with good results. It has also been down on the Furness Railway for seven years, near Barrow, for trial in comparison with the English type of road, where it may now be seen giving satisfactory results. Last year this rail-joint was adopted on the Swedish State line for my 90-lb. rail. It gives the best line for the least money compared with the main lines in Europe, and it may thus be taken for the best type of the suspended joint. The larger bearing surfaces which my new rail sections offer have been of material advantage in supporting the joint, but although it carries the same load in testing as the solid rail, good ballasting is required to give good results. The use of coarse stone ballast has proved to be the best means of keeping the joint up, but it is very expensive, and in some localities it is almost impossible to obtain.

It is therefore important to find a design of joint, whether supported or suspended, that will give the best road with ordinary ballast and maintenance. I have designed a three-sleeper supported rail-joint, with angular fishplates for the same rail as the Goliath suspended joint. The weight of the fishplates for both joints is about the same, but the fishplates for the Goliath joint have spike holes and direct bearing on the sleeper, while for the supported joint they have slots to prevent creeping of the rails.

To prevent the flattening of the rail ends, the steel has been lately increased in hardness by chemical composition, particularly by carbon; but the International Railway Congress, held in London, 1895, refused to confirm a former resolution to the effect that a harder steel should be recommended. On the contrary, the majority stated that the question is not sufficiently matured, and the English engineers particularly were in favor of a rail steel of medium hardness.

Bearing in mind that the harder the rail the more it is apt to break in many pieces when weakened by long service, it would be a dangerous practice to resort to excessive hardness, particularly in countries with cold climates. The slight gain in hardness between .45 and .55 per cent. carbon is more than balanced by the greater risk of fracture, and such means should only be resorted to with great caution, and after all has been done in the direction of improved joints, best ballast obtainable, and the most careful maintenance.

The supported rail-joint has now a greater chance in competition with the suspended one than 30 years ago, for not only is it supported by three sleepers, instead of one, but both fishplates and rails can be rolled with flatter and sharper bearing surfaces than formerly, which is of great service in holding up the joint, if the designer of the rail sections has taken advantage of this progress in rolling steel.

Even in England the supported joint is gaining ground, and several railways are trying it, for instance, the London & Northwestern are trying Webb's patent chair. The London, Chatham & Dover Railway adopted joint chairs some time ago, and they are now generally used on their system and give satisfactory results.

Regarding the increased weight of rails, it is no doubt very good also for the joint, but it is not sufficient to increase the weight alone; the material must also be distributed in a good rail section for fishing. This is often overlooked, and the expected advantages of a heavier rail are not then realized.

At the last International Congress it was decided that where express trains were run with a speed of 50 miles or more per hour, the weight of the rails should be 80 pounds or more per yard. When I, in 1886, suggested my 100 pounds per yard section to the Belgian State Railways, I was considered extravagant. The three largest railways in England have now increased the weight of their rails to 100 pounds or to 103 pounds, besides having a chair weighing about 50 pounds, which should improve the joint in proportion.

THE WESTINGHOUSE COMPANY BUYS THE BOYDEN BRAKE.

The "New York Commercial" of June 27 prints the following:

"At a meeting yesterday of the stockholders of the Boyden Brake Company an offer from the Westinghouse Air-Brake Company to buy out the Boyden Company was accepted unanimously. The price named was $900,000. This sum will pay off the floating debt and the preferred stock of the Boyden company, and besides net the holders of the common stock $25 a share. The common stock of the company amounts to $3,000,000.

"At the meeting a committee composed of Messrs. Douglas H. Thomas, Charles D. Mann and Theodore G. Lurman was appointed to conclude the sale. It is said it will take four or five months to conclude the transaction.

"The action of the stockholders of the Boyden company closes one of the most notable patent cases in the history of the country. The fight between the Boyden and Westinghouse companies was hotly contested. The Westinghouse, which had enjoyed a monopoly of the air-brake business before the Boyden invention, claimed that the latter was an infringement on their patent on quick-acting brakes. The case was taken to the Supreme Court of the United States. The decision was rendered upholding the claims of the Boyden company."

MAGNOLIA METAL COMPANY WINS A SUIT.

The Magnolia Metal Company, manufacturers of the well-known "Magnolia" anti-friction bearing metal, informs us that they have secured a permanent injunction in the United States Circuit Court for the Southern District of New York, before Judge Wallace, against Benjamin and Moses Lowenstein, trading under the firm name of the Nassau Smelting and Refining Company of New York, restraining them from offering for sale or advertising "Magnolia Anti-Friction Metal." The decree of the Court is as follows:

"Ordered, adjudged and decreed that the complainant, the Magnolia Metal Company, is the owner of a good and valid trade-mark, consisting of the word 'Magnolia,' as applied to anti-friction metals and alloys made and sold by it, and is entitled to the sole and exclusive use thereof, and that the defendants, Benjamin Lowenstein and Moses Lowenstein (trading as the Nassau Smelting and Refining Co.), have, by the use of the word 'Magnolia' upon anti-friction metal made and sold by them, violated and infringed upon the exclusive rights of the complainant in the premises; and it is further ordered, adjudged and decreed that the defendants, Benjamin Lowenstein and Moses Lowenstein, and each of them, their and each of their attorneys, agents, servants, clerks, salesmen and employees and each of them, and all persons acting under them or their authority by, and they hereby are perpetually enjoined and restrained from infringing the complainants' said trade-mark and rights; and from marking, designating or advertising an anti-friction or other like alloy or metal as 'Magnolia;' and from using on any alloy or metal for anti-friction or like purposes, or in conjunction with manufacture or sale thereof, the word 'Magnolia,' or any other word calculated to deceive the public by a like close imitation of the complainants' trade-mark 'Magnolia;' and it is further ordered, adjudged and decreed that the complainant recover from the said defendants, as well, the damage sustained in or by reason of said infringement as the profits, gains and saving made or realized by the defendants thereby."

For the past eight months the Baltimore & Ohio Railroad has been keeping an accurate account of the tons carried per train mile on the entire system in order to ascertain to what extent the improvements had increased the train haul. The results have more than justified the expectation as the average for the eight months ending Feb. 28 is 323.13 tons per train mile. This is certainly a good showing, as the average in years gone by has not exceeded 225. The average for the year will doubtless be much larger.

EQUIPMENT AND MANUFACTURING NOTES.

The Baltimore & Ohio Railroad carried 28,663 persons in special parties during the month of May, not counting regular and Decoration Day passengers. Of this number 19,000 were troops en route to Falls Church and Chickamauga.

An affiliation between the Niles Tool Works and the Pond Machine Tool Works is announced. This deal does not appear to be a consolidation, but it is sure to result in improvement in the condition of the heavy tool business. It is also announced that new works are to be built at Berlin, Germany, to be known as the Deutsche Niles Werk-zeug Machinen Fabrik. This means a Niles works in Germany.

The Baltimore & Ohio is introducing a great improvement in the accommodations for women in the new parlor cars recently built for the trains of the Royal Blue Line between New York and Washington. Three of these cars which are now in service contain ladies' retiring rooms. These apartments are 8 feet long, and are provided with full-length mirrors, cushion settees, stationary dressers, book-cases and all possible conveniences that can be found in a ladies' boudoir. The finishing is artistic and beautiful. The new cars are the longest of the kind ever built, being 70 feet in length, exclusive of platforms.

The Ashton Valve Company, of 271 Franklin street, Boston, has sent us the most attractive desk blotter we have ever seen. It bears a good half-tone portrait of Admiral George Dewey, and "Old Glory" and the Cuban flag embossed in colors with the seal of the United States in colors and gold over the crossed staffs of the flags. It is a good blotter, but is too handsome to be used in that way.

"Chicago Rabbeted Grain Doors" were specified on 200 box cars for the Chicago, Rock Island & Pacific, and 500 cars for the Canadian Pacific, building at the shops of the roads. The "Security Lock Brackets" are to be used on the Canadian Pacific cars, and also on the following cars contracted for in the month of May: 1,000 cars for the C., C., C. & St. L. Ry., building at Pullman; 500 cars for the Rock Island, by the Michigan Peninsular Car Company; 500 cars for the "Soo Line" and 1,000 cars for the Illinois Central.

The proper lubrication of gas engine cylinders has been a very difficult problem. The problem, however, seems to have been very successfully solved by an official of the Pennsylvania Railroad Company. He writes as follows: "I had a gas engine at Sharon, Pa., running a pump, and the man who had charge of it allowed the lubricator to run dry and cut the piston, piston rings and cylinders. The makers of the gas engine said the cylinder would have to be sent to the shop and bored out and a new piston put in. It was our busy season and we could not do without water. I had some of Dixon's finely pulverized graphite, and I commenced to feed it into the cylinder through the suction pipe with the air and gas, with immediate relief. After about two weeks the engine was running smoother and using less gas than ever before. I had this same engine apart last Saturday, and every place that was cut is smooth as glass. This one instance saved us about $75. I have great faith in this graphite, and always keep it on hand."

The "Diamond S" brake shoe patents are now owned by the American Brake Shoe Company, of which Mr. W. D. Sargent is President. This company was organized for the purpose of maintaining a careful inspection of the product of all of the licensees under these patents, and to insure uniformity of manufacture throughout the country, so that the railroads using these shoes will be guaranteed a continuance of the good results obtained from these shoes as manufactured by the Sargent Company. An inspection of shoes in service will be maintained in order to give the roads the benefit of the services of the company's experts. The licensees are as follows:

The Sargent Company—Old Colony Building, Chicago, Ill.; Security Building, St. Louis, Mo.; Endicott Arcade, St. Paul, Minn.; 537 Mission street, San Francisco, Cal.

The Ramapo Iron Works—Hillburn, N. Y.; Havemeyer Building, New York, N. Y.

Parker & Topping—Endicott Arcade, St. Paul, Minn.; Albina Foundry, Portland, Ore.

Central Brake Shoe Company—Ellicott Square, Buffalo, N. Y.; Havemeyer Building, New York, N. Y.

PAMPHLETS RECEIVED.

"Purdue University; Announcement of Courses in Railway Engineering and Railway Management, 1898-99."

This pamphlet contains a general announcement of the department devoted to railway engineering and railway management, a statement of courses of study and practice and engineering research, a detailed statement of equipment and lists of officers and lecturers, who are to present the practical side of railroad work to the students during the coming college year. The pamphlet will interest prospective students and all who are concerned in the adaptation of college instruction to the subject of railroads.

Brill Standard Sprinkling Cars. An illustrated 8-page pamphlet, issued by the J. G. Brill Co., Philadelphia, Pa., May, 1898. The Brill standard sprinkling cars are described and illustrated, information in regard to capacity, sizes and fixtures, pumps and separate motors, enclosed tanks and the value of sprinklers being given. The standard sprinkling car consists of a 2,500-gallon tank mounted on a solid seasoned oak frame and carried on a solid forged frame four-wheel truck with double spiral springs at each box. This amount of water will sprinkle from 5½ to 8 miles of road. The sprinklers are specially designed to prevent obstructions. Other sizes of tanks and other arrangements of the car, including suction pumps and separate motors are provided when required.

INSPECTION OF WOODEN BRIDGES.

In an address at a recent meeting of the employees of the bridge and building department of the Chicago, Milwaukee & St. Paul Ry., Mr. William Gannon gave the following account of the method of inspecting wooden bridges on that road: Wooden bridges should be inspected twice a year, the best time being in the spring and the fall. Those who inspect should have knowledge of the life and strength of timber, parts most apt to decay and places most liable to pull or strain apart. Our mode of inspection is to have a crew consisting of the district or chief carpenter, foreman of bridge crew, three bridge carpenters and the bridge inspector, with a light hand car. The tools we take with us are. Three sharp-pointed bars; 3 braces; 4 auger bits, one-half inch by 2 feet 6 inches over all; 2 hand axes; 1 square; 1 hand saw; 1 shovel; 1 chisel; 1 extension pike pole; 2 pounds nails. We look all bridges over carefully, and on pile bridges two men take the sharp-pointed bars and try the piles from 2 to 3 inches below the surface of the ground, calling attention to any piles that have only 6 inches or less of good timber in them. The inspector and the balance of the men look the caps, stringers and ties over, and the Inspector and District Carpenter decide the amount of boring and in what places it should be done. On Howe truss span bridges we look them over carefully, and when they are over 5 years old test them with a bit and sound the timber with a bar or a hand ax; the older the bridge is the more it is tested.

EXHIBITS AT THE CONVENTIONS.

The following is the list of the companies exhibiting at the recent conventions at Saratoga:

Adams & Westlake, Chicago, Ill.

Allan-Morrison Brake Shoe Company, Chicago. Composite brake shoes.

American Brake Shoe Company, Chicago, brake shoes and tinted picture showing those parts of a locomotive which have been made of cast steel.

Ajax Mfg. Co., Cleveland, O.

Anglo-American Varnish Company, Newark, N. J.

Ashton Valve Company, Boston, Mass. Ashton standard muffler safety valves, Ashton adjustable ring muffler safety valves, Ashton open pop safety valves, both plain and with cam lever; Ashton double spring locomotive steam gages, Ashton double spring duplex air gages.

American Steel Foundry Company, St. Louis, Mo. Models of the American steel truck and bolster.

Bird & Son, F. W., East Walpole, Mass, car roof.

Bushnell Manufacturing Co., Easton, Pa. Car seats.

Boston Belting Co., Boston, Mass. A full line of hose, rubber packing and mechanical rubber goods.

Boston Woven Hose and Rubber Company. Boston and Chicago. Rubber Hose.
Buck Manufacturing Co., St. Louis, Mo.
Buckeye Malleable Iron and Coupler Co., Columbus, O.
Burrowes Co., The E. T., Portland, Me. Car curtains.
Chicago Railway Equipment Co., Chicago. National Hollow Brake Beams, automatic frictionless side bearings and air-brake controller.
Chicago Pneumatic Tool Co., Chicago and New York. Pneumatic riveters, hammers, hoists, staybolt nippers, sand papering machines, painting machines, drill presses, flue rollers and reducer and speed recorder.
Cleveland City Forge & Iron Co., Cleveland, O. Turnbuckle for "the coming car."
Cloud Steel Truck Co., Old Colony Building, Chicago. Cloud pressed steel truck and Bettendorf I beam body and truck bolsters.
Corning Brake Shoe Co., Corning, N. Y. Brake shoes.
Crosby Steam Gage & Valve Co., Boston, Mass.
Davis Pressed Steel Co., Wilmington, Del., Davis tight-joint journal box.
Detroit Lubricator Co., Detroit, Mich. The Detroi Lubricator.
Diamond Rubber Co., Akron, O., air brake hose and a complete line of railway rubber goods.
Facer Forged Steel Car Wheel and Locomotive Wheel Co., Germantown, Pa. Steel forged wheels for locomotives and cars.
Fox Pressed Steel Equipment Co., New York. Models of the Fox truck.
Gold Car Heating Company, New York, complete car heating equipment under steam pressure.
Goodwin Car Co., New York, photos showing Goodwin dump car.
Gould Coupler Co., New York and Chicago. Automatic car coupler.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.
Hancock Inspirator Co., Boston, Mass. Hancock inspirator in four types, boiler checks, hose strainer and a large ejector.
Hammett, M. C., Troy, N. Y., Stevenson belt dressing.
Homestead Valve Mfg. Co., Homestead, Pa. Valves.
Joyce, Cripland & Co., Dayton, O.
H. W. Johns Manufacturing Company, New York.
Keystone Axle Co., Pittsburgh, Pa.
Knitted Mattress Co., Canton Junction, Mass., seat mattresses.
Lackawanna Lubricating Co. Scranton, Pa. Lubricators.
Leach, Henry L., North Cambridge, Mass. Pneumatic sander.
McCord & Co., Chicago. Journal box and hopper bottom door.
Mason Regulator Co., Boston.
Massachusetts Mohair Plush Co., Boston, Mass.
Manning, Maxwell & Moore, New York. Metropolitan injector, consolidated safety valve and Ashcroft gage.
Michigan Malleable Iron Co., Detroit, Mich. Solid couplers and Thornbergh coupler detachment.
Monarch Brake Beam Co., Detroit. The Monarch and the Solid freight and passenger brake beams.
McVicar & Sweet, Denver, Colo., McVicar oil cups.
National Elastic Nut Co., Milwaukee, Wis.
New York Belting & Packing Co., Ltd., New York.
Norton, A. O., Boston, Mass., Norton jacks.
National Malleable Casting Co., Cleveland, O. Tower coupler with lock set.
Ohio Falls Car Mfg. Co., Jeffersonville, Ind. Buckeye steel truck.
Oval Brake Beam Co., Philadelphia, Pa., brake beams.
Pantasote Leather Co., New York, car curtains, car seats and car headlinings.
Peerless Rubber & Mfg. Co., New York, a full line of mechanical goods, including rainbow packing.
Pottier & Stymus Co., New York, car seats.
Pratt & Letchworth Co., Buffalo, N. Y., cast steel wheel centers, driving boxes and crossheads and malleable iron journal boxes, Pooley couplers, and other freight car castings.
Q. & C. Co., Chicago, brake slake adjuster and Wood seal lock. Pneumatic tools, Stanwood steel step.
Rand Drill Co., New York, 30 H.-P. air compressor.
Reed Mfg. Co., Erie, Pa. Pipe wrench.
Richmond Locomotive Works, Richmond, Va., compound locomotive on D. & H. tracks.
Rochester Automatic Lubricator Co., Rochester, N. Y., automatic lubricator.
Safety Car Heating & Lighting Co., New York.
Schoen Pressed Steel Co., Pittsburgh, Pa., pressed steel cars.
Simplex Railway Appliance Co., Chicago, truck and body bolsters.
Sellers, Wm., & Co., Philadelphia, Pa., check valve, automatic injector and strainer.
Standard Car Truck Co., Old Colony Building, Chicago, Ill., standard car truck.
Standard Coupler Co., New York, Standard Steel platform and standard couplers.
Sterlingworth Railway Supply Co., Easton, Pa., Sterlingworth brake beams and steel trucks.
Universal Car Bearing Company, New York, Car Bearing
Westinghouse Air Brake Co., Pittsburgh. Westinghouse Friction Draft Gear and Automatic Air and Steam coupler, on exhibition on cars on D. & H. tracks.
Westinghouse Machine Co., Pittsburgh. Three cylinder, 55 H.-P., gas engine, direct connected with electric generator.
Wheeler Car Seat Co., Chicago, car seats.

OUR DIRECTORY

OF OFFICIAL CHANGES IN JUNE.

Adirondack.—Mr. James J. Traver, formerly Master Car Builder of this road, died May 20, at the age of 82 years.

Baltimore & Ohio System.—Mr. James Fitzgerald, Vice-President of the Staten Island Railroad, which is part of this system, died at his residence in New York City May 26, at the age of 60 years.

Bangor & Portland.—Mr. C. A. Ward has been appointed Master Mechanic, with office at Bangor, Pa., succeeding Mr. George Holmes.

Central Ontario.—Mr. H. S. Johnson has been elected Vice-President, vice H. P. McIntosh.

Central Railroad of New Jersey.—Mr. J. R. Slack has been appointed Mechanical Engineer.

Chesapeake & Ohio.—Mr. H. Frazier has resigned as Chief Engineer.

Chicago, Rock Island & Pacific.—Mr. Warren G. Purdy has been elected President. He was formerly First Vice-President. Mr. R. R. Cable declined a re-election to the Presidency, and was elected Chairman of the Board of Directors. Mr. W. H. Truesdale was chosen First Vice-President. He was formerly Second Vice-President and General Manager.

Chicago Terminal Transfer.—Mr. Edward D. Adams has been elected President and Chairman of the Executive Committee, and Mr. S. R. Ainslie, Vice-President and General Manager.

Columbus, Sandusky & Hocking.—Mr. J. W. Stokes has been appointed Master Mechanic, with headquarters at Columbus, Ohio. He was formerly Master Mechanic of the Illinois Central.

Detroit & Lima Northern.—Mr. C. W. Taylor has been appointed Purchasing Agent, succeeding Mr. C. H. Roser. His headquarters will be in Detroit, Mich.

Detroit & Milwaukee.—Mr. Benjamin Briscoe, formerly for many years Master Mechanic, died May 2, at the age of 66 years

El Paso & Northeastern.—Mr. C. F. Winn, formerly Joint Foreman of the Denver & Rio Grande and the Rio Grande Western, at Durango, Col., has been appointed Master Mechanic of the E. P. & N. E., with office at El Paso, Tex., succeeding Mr. George F. Miller.

Fitchburg.—Mr. J. W. Marden has been appointed Superintendent of Motive Power, to succeed Mr. John Medway.

Fremont, Elkhorn & Missouri Valley.—Mr. Carey Turner has been appointed Assistant Master Car Builder, with headquarters at Omaha, Neb. He was formerly employed in the car department of the Central Branch shops, at Atchison.

Great Northern.—Mr. J. F. Stevens, for the past three years Chief Engineer, has tendered his resignation, on account of ill health.

Great Northern.—President James J. Hill announces that the vacancy caused by the resignation of Mr. W. H. Newman to accept the Presidency of the Lake Shore & Michigan Southern, will not be filled.

Indiana, Illinois & Iowa.—Mr. F. P. Shonts has been elected President. He was formerly General Manager. He succeeds Mr. Drake.

Interoceanic.—Mr. L. H. Sherman has resigned as Master Mechanic, at Pueblo, Mex., and has returned to his former home, Houston, Tex.

Illinois Central.—Mr. L. L. Dawson has been appointed Master Mechanic of the Illinois Central shops, at Memphis, Tenn.

International & Great Northern.—Mr. Leroy Trice has been elected Second Vice-President, succeeding H. B. Kane. Mr. Trice also continues to be General Superintendent.

Leavenworth, Kansas & Western.—Mr. Horace G. Burt is President, with office at Omaha, Neb.

Lake Shore & Michigan Southern.—President Newman of this road announces that Mr. W. H. Canniff having resigned as General Manager, that office has been abolished, and Mr. P. S. Blodgett, in addition to his present duties, as General Superintendent, will have charge of such matters as have heretofore been under the jurisdiction of the General Manager. Mr. P. P. Wright, Assistant General Manager, will continue to discharge the duties heretofore assigned to him.

Missouri, Kansas & Texas.—Mr. John N. Simpson, Third Vice-President of this road, has been elected Second Vice-President.

Manistique & Northwestern.—Mr. Abijah Weston, President of this road, died at Tonawanda, N. Y., June 6, at the age of 75 years.

Minneapolis, St. Paul & Ste. Marie.—Mr. Thomas Green has been appointed Acting Chief Engineer, vice W. W. Rich, previously Chief Engineer.

New York Central & Hudson River.—Mr. W. J. Wilgus has been appointed Engineer of Maintenance of Way, with headquarters in New York, and the office of Chief Assistant Engineer has been abolished.

Norfolk & Southern.—Mr. Herbert Roberts has been appointed Superintendent of Motive Power, succeeding Mr. G. R. Joughins.

Northern Central.—Mr. Daniel S. Newhall, the new Purchasing Agent of the Pennsylvania, was elected to the same office on

this road at the election held on June 4 in Philadelphia. Mr. Lewis Neilson was elected Assistant Secretary, to succeed Mr. Newhall.

Ogdensburg & Lake Champlain.—Mr. Theodore Butterfield has been appointed General Manager, with office at Ogdensburg, N. Y. Mr. C. G. Chevalier has been appointed Purchasing Agent, with office at Ogdensburg, N. Y.

Pittsburgh & Lake Erie.—At a special meeting of the Directors of this company, which is controlled by the Lake Shore & Michigan Southern, Mr. W. H. Newman, the new President of the L. S. & M. S., was unanimously chosen President. Mr. Callaway, the new President of the New York Central, was heretofore President of the P. & L. E.

Pennsylvania.—Mr. Daniel S. Newhall has been chosen Purchasing Agent by the Board of Directors, to succeed Mr. A. W. Sumner, deceased.

Richmond, Fredericksburg & Potomac.—Mr. J. S. Cooper has been appointed Master Mechanic, with office at Richmond, Va., to succeed Mr. J. T. Bryant, deceased.

Santa Fe Pacific.—Mr. T. F. Underwood has been appointed Master Mechanic, with headquarters at Winslow, Ariz.

St. Louis, Peoria & Northern.—Mr. J. W. Hemphill has been appointed Master Mechanic, with headquarters at Springfield, Ill., vice Mr. A. L. Moler.

Seivern & Knoxville.—Mr. R. A. Springs is President of this road, which is operated by the officers of the Carolina Midland Ry.

St. Louis, Peoria & Northern.—Mr. Alexander Rumpler has been appointed Assistant to the President. He was formerly Assistant to George W. Stevens, Superintendent of Motive Power of the Lake Shore & Michigan Southern. His office will be at St. Louis, Mo.

Temiscouata.— Mr. E. D. Boswell, President of this road, died at Riviere du Loup, Quebec, June 3, at the age of 50 years.

Utah Central.—Mr. George G. Bywater, formerly Master Mechanic of this road, died May 16, at the age of 69 years.

Washington County.—Mr. William Barkley Parsons has been appointed Chief Engineer. He succeeds Mr. G. M. Rushing resigned.

West Shore, New Jersey Junction & Wallkill Valley.—Mr. J. D. Laying, Second Vice-President and General Manager, has issued the following circular under date of May 30, 1898: "G. E. Hustis is hereby appointed General Superintendent of the West Shore, Wallkill Valley and New Jersey Junction Railroads, in place of C. W. Bradley, resigned.

West Virginia & Pittsburgh.—Mr. A. H. Kunst has been appointed General Manager, with headquarters at Weston, W. Va.

Western Transit.—Mr. S. D. Caldwell, formerly for thirteen years General Manager of this road, the lake line of the New York Central Railroad, died at his home in Buffalo, N. Y., May 27, at the age of 70 years.

MASTER CAR BUILDER'S ASSOCIATION.

Thirty-second Annual Convention.

Reports of Committees.

SPECIFICATIONS FOR AIR-BRAKE HOSE.

A. M. Waitt, Committee.

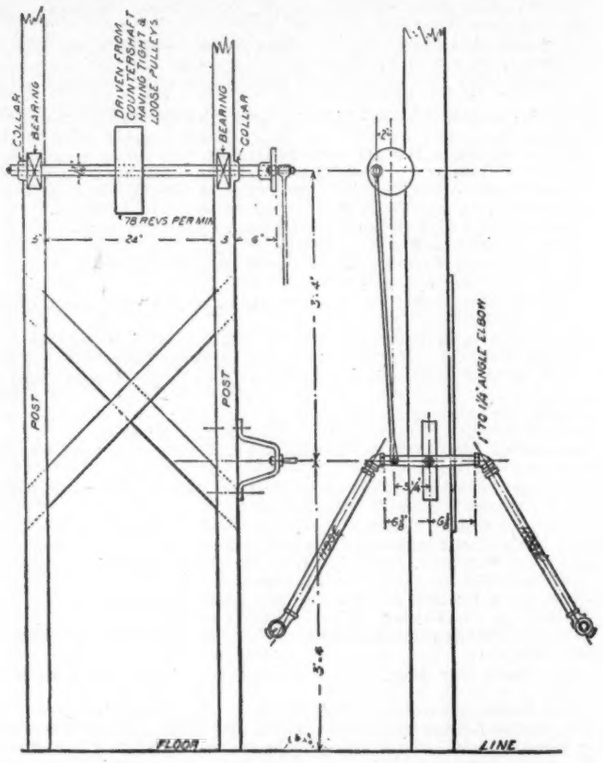
If it is considered that there are over 650,000 cars and locomotives in this country at the present time equipped with air brakes, and that the highest guarantee given on the life of air hose by manufacturers is only twenty-four months, and that a large percentage of the air hose are renewed for defects not inherent in the hose before they are twenty-four months old, it will be seen that the railways of this country require probably over 600,000 air-brake hose, costing with present prices almost, if not quite, $1 each, to supply the requirements for yearly renewals.

There is a general impression that the strength of an air hose to resist bursting is the one great requisite. It is a fact, however, that almost any hose in the market will withstand an initial bursting pressure many times greater than the maximum strain put upon it in ordinary use.

There seems to be a generally accepted opinion, but without any good reason therefor, that it is necessary for an air-brake hose to be made four-ply—that is, composed of four wrappings of heavy cotton canvas—in order to make it of sufficient strength to stand the strains put upon it in service. Tests made, by bursting a large number of hose of various plies and various styles of manufacture, have shown that four-ply air hose are made which will burst at 400 pounds pressure, while other hose made with only two-ply fabric, but manufactured by a different method, cannot be burst at pressures of over 1,200 pounds. In the construction of an air hose, the canvas or cotton fabric can be considered as the foundation upon which the structure is built. On the fabric alone reliance must be placed for strength to resist the pressures that are put upon it. With an air-brake hose on freight cars, 90 pounds is about the maximum pressure that they are called upon to resist. If hose are specified to stand a bursting test of 500 pounds, a factor of safety of a little over 5½ is thereby required, which seemingly should be amply high for all requirements.

[A description in detail of the manufacture of hose is given by the author. For a similar description see our issue of October, 1897, p. 335.—Editor.]

During the past two years a new style of hose known as the tubular construction has been quite largely introduced. As I shall have more to say of this form of construction later on, and as its method of manufacture is in some respects radically different from the wrapped hose, it will doubtless be interesting to follow the process. In the tubular form of hose it seems to be quite convenient to make them on mandrels of sufficient length to produce two hose at a time. The mandrel is hollow, about five feet long, and of diameter suited to the inside diameter of the hose. A sheet of thin rubber for the tube is cut to proper length for two hose, and of proper width to wrap around the mandrel two or three complete turns. This sheet is laid on a perfectly flat and smooth table, and the mandrel, well soapstoned, is laid on it and rolled over it two or three times, thus

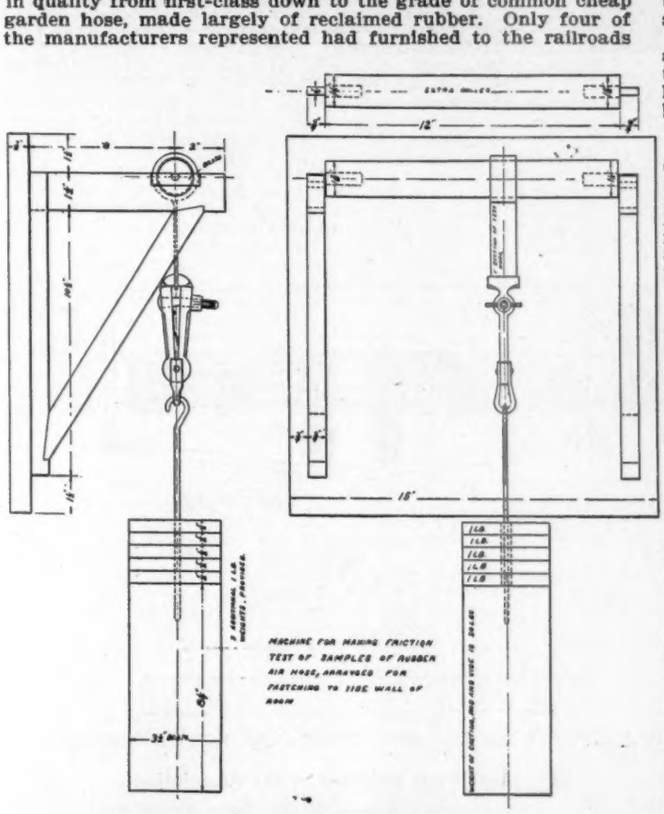


Machine for Testing Hose by Kinking.

forming the tube, the lapping edge afterward being rolled down with concave roller. The mandrel with its tube cover is next placed in position in center of a weaving machine similar to that used in making tubular lamp wicking, and while in this position a cotton covering is woven around it, the mandrel being fed through the machine at same speed that fabric is woven. The tightness of fit of tube and the closeness of weaving is perfectly adjustable, as well as the thickness of the fabric, which can be varied by increasing the number of threads used. After the first layer of fabric is woven, the inclosed mandrel is placed on a rack over a trough filled with rubber cement The newly woven tube is first given a thorough coating of very thin rubber cement, and after this is sufficiently dry several succeeding coats of greater density are applied, proper time for drying being allowed between the coats. This process completely fills all the pores of the fabric, excludes the air, and cements the fabric together, and to the tube, and also provides an adhesive surface for the friction coat. After the cement coats are applied the mandrel is placed on the table and a friction coat of rubber one thirty-second or sixteenth inch thick is applied in the same manner as the original inner tube, the lapping edges as well as the balance of the covering being carefully rolled down so as to exclude all air. Next, another tube of fabric is woven over the rubber friction coat, and again the texture of the fabric is filled with rubber cement as before, after which the cover is applied in the usual way. The hose are now cut to proper lengths while on the mandrel and a thin

rubber cap piece is applied, and the hose is then ready for the usual wrapping in wet cotton cloth and the subsequent vulcanizing.

The use of inferior materials in hose manufacture, combined with the greatest care in the process of construction or the use of the best material with carelessness in putting it together, is sure to produce hose which will give unsatisfactory service and short life. With the object of ascertaining what steps have been taken by the railroads represented in this Association to insure proper materials and processes of manufacture in the construction of air hose and also with a view of ascertaining what qualities of air hose are being accepted and used by the railroads, a circular of inquiry was sent out to representative members of our Association, asking for copy of specifications under which their hose are purchased, and the qualifications required by tests before acceptance, also a sample of hose purchased was asked for. Very few replies were received—only twenty-two out of the entire number of roads represented. The reason for this may be inferred from the nature of some of the replies, namely, that no attention whatever has been given to the subject by 90 per cent. of our companies. That it should have instant and urgent attention is shown by the results developed in tests of twenty-six sample hose received for test. These were of eight different makes, and undoubtedly of greatly varying prices. They range in quality from first-class down to the grade of common cheap garden hose, made largely of reclaimed rubber. Only four of the manufacturers represented had furnished to the railroads



Apparatus for Testing "Friction" of Hose.

hose which, in the matter of good friction and good rubber properly cured, would meet the requirements of the specifications of the Lake Shore, Erie and Baltimore & Ohio railroads.

If the hose successfully resists a pressure of 500 pounds, a section one inch long is cut from some part not near the rupture, and by means of a knife the outer cover is cut through to the first wrapping of duck or woven fabric, and with the aid of a pair of pliers this outer course is separated from the balance for about one inch. A convenient clamp is next attached to the free end and the section is slipped as far as possible onto a slightly tapered wood or metal spindle, which has an outer diameter about the same as inside diameter of hose. This spindle is placed in its position in a friction-testing machine, which is shown in Fig. 1, and a 25-pound weight is suspended from the separated end by means of the clamp. The distance that the hose unwraps in ten minutes determines if the friction meets the requirements.

After the one-inch section is unwrapped to the tube, if made in the best manner, it should be found very difficult to separate the rubber of the inner tube from the canvas wrapping. A little experience, however, aided by a few drops at a time of naphtha, will enable the separation of rubber tube, rubber cover, and even the friction skimming coat, all of which are then tested in the stretching testing machine shown in Fig. 2. If the test hose successfully passes the friction and stretching tests, all of the hose in the shipment are examined to note their compliance with the balance of the requirements.

The scrap pile is always a good and fruitful field for observation as to causes of weakness or removal of defective parts of equipment. From the hose scrap pile we find prominent among the causes of disability among hose:

1. Kinked, with rubber of cover badly cracked at kink, exposing canvas to the weather and causing leakage. In these hose it will often be found by opening up the hose that the rubber in the tube is cracked near the kink, and there is nothing to prevent moisture inside the hose from working into the canvas and following it round and round till it reaches the outside of hose. Where the moisture goes the air can follow, hence from this cause we may have many leaky and burst hose. There is far less danger from the cracking of the cover, as there is no air pressure to help force the moisture inward. Another effect of kinking is to cause a separation between the different layers of the hose, and also to break the fiber of the cotton in the canvas and weaken it at that point.

2. Porous or leaky around the ends of the hose near fittings. An examination of the interior of such hose after the fittings have been carefully removed will show in a large number of cases that the rubber tube has been slightly torn or cut, either wholly or nearly through the canvas, caused by bruising of tube in forcing the fittings on carelessly, or by cutting of tube by roughness of the fittings.

3. Chafed or cut by chafing. This is a quite common cause of hose removal. It comes from being hit or rubbed, generally at the nipple-fitting end, thereby bruising or cutting the cover, sometimes into the first or second ply of canvas.

There are forms of construction of hose in which the canvas and the rubber accommodate themselves with equal facility to the bending, as is shown by the fact that with such hose on the kinking machine there is no perceptible heating at the point of bend, and consequently no tendency to change the normal relation between the fabric and the rubber.

The form of construction last referred to is the tubular. Long-continued tests on the kinking machine have shown that the tubular form of hose will outlast from three to four of the best make of three or four ply wrapped hose, before showing a leak, Experience with such tests has failed to develop over 33,000 revolutions of the machine with four-ply hose before hose would commence to leak at the bend, while with the two-ply tubular hose it required a little over 1,000,000 revolutions to cause a leak.

The objection to excessive expansion, on account of its causing the rubber to crack more quickly, is a reasonable and strong argument for having hose made with enlarged ends. The ordinary 1¼-inch hose is seven thirty-seconds inch less in inside diameter than the small end of the Westinghouse fittings, and ⅜ inch less than the enlarged part of the fitting. It surely is not good practice to put rubber into the hose and then require it to be permanently stretched ⅜ inch in diameter in order to force the fittings on, when with a little more work by the manufacturer the hose can have slightly enlarged ends which will take the fittings quite readily, and without stretching and straining the rubber and canvas, and thereby surely shortening its ultimate life. Another reason for enlarged ends is the fact that the air-brake fittings are unfinished malleable castings, which oftentimes have small rough or sharp projections on them, which are very liable to cut or tear the inner tube of the hose.

Quite extensive experiments have indicated to the writer that a simple two-ply hose, properly made with 22-ounce duck, can be made strong enough in its resistance to bursting pressure, but it will not give safeguard enough against results of chafing of cover or tearing of tube. If, however, in addition, the composite cover and tube are used, a hose is obtained, if good materials properly put together are used, that is soft, pliable, and of sufficient strength to resist a bursting pressure of from six to eight hundred pounds.

In concluding this paper, it will be desirable to summarize the deductions from the discussion of the various points, by outlining a short draft of a specification which will at least insure by its use the obtaining of reliable hose, well made, and of a higher grade than the average now manufactured, and which will undoubtedly give longer service than a large percentage of the hose used in the past.

[Recommended Specifications for Air-Brake and Signal Hose.]

1. All air-brake and signal hose must be soft and pliable, not less than two-ply nor more than four-ply.

2. The tube must be hand-made, composed of not less than two calenders of thin rubber; it must be free from holes, or imperfections in joining, and must be so firmly united to the cotton fabric that it cannot be separated readily without breaking or splitting the tube. The tube must be of rubber, of such composition and so cured as to successfully meet the requirements of the stretching test given below. The tube must not be less than three-thirty-seconds inch thick at any point. It may preferably be made in composite form, with a complete inner tube of one-sixteenth inch rubber wrapped with a single wrapping of 8-ounce cotton canvas, the whole being covered with an outer tube of one thirty-second inch thick rubber.

3. The canvas or woven fabric used as wrapping for the hose to be made of good quality cotton, loosely woven, and to weigh not less than 22 ounces per yard, and to be from 38 to 40 inches wide, except when woven with a seamless tubing. The wrapping must be frictioned on both sides, and must have in addition a distinct skimming coat or layer of gum between each ply wrapping not less than one thirty-second inch thick. The friction and coating must be of the same quality of gum as the tube. The canvas wrapping to be cut and applied on the bias.

4. The cover must be of the same quality of gum as the tube, and must not be less than one-sixteenth inch thick. The cover may preferably be made in composite form in the same manner

as provided for with the tube. In this case there must be not less than one thirty-second inch thickness of rubber between the outer ply of wrapping and the 8-ounce duck forming part of the cover, and there must be an equal thickness of rubber on the outside.

5. Air-brake and signal hose are to be furnished in 22-inch lengths. Variations exceeding ¼ inch above or below this length will not be accepted. The inside diameter of all such hose to be not less than 1¼ inches, nor more than 1 5-16 inches, except on the ends, which are to be enlarged to 1 7-16 inches for a distance of 2¾ inches, the change from larger to smaller diameter to be made tapering, so that inside of hose will be practically smooth. The outside diameter must not exceed 2 inches nor be less than 1⅞ inches in the main part, or exceed 2 3-16 inches, or be less than 2 1-16 inches at the enlarged ends. Hose must be finished smooth and be regular in size throughout, as above indicated; ends of hose to be capped with from 1-16 to ⅛ inch of rubber. Caps must be vulcanized on, not pasted or cemented.

6. Each standard length of hose must be branded with the name of the manufacturer, year and month when made, and the standard railroad mark, and also have a table of raised letters at least three-sixteenths inch high, to show date of application and removal.

All markings except the road mark may be combined in one plate.

All markings to be full and distinct, and made of a thin layer of white or red rubber vulcanized on, and so applied as to be removable only by cutting with a knife or sharp instrument.

7. Air-brake and signal hose will be subjected to the following tests:

Each hose must stand a proof pressure test of 300 pounds without failure of any kind. With every lot of two hundred or less shipped to one point, the manufacturer must furnish free of charge one additional hose for test. From each such lot one hose will be taken at random, and subjected to the following tests in the order named:

Bursting Test.

The test hose must stand a hydraulic pressure of 5000 pounds before bursting, and must not expand more than ⅛ inch in diameter under a pressure of 100 pounds.

Friction Test.

A section one inch long will be taken from any part of the hose, and the friction determined by the force and time required to unwind the hose, the force being applied radially. With a weight of 25 pounds suspended from the separated end, the separation must be uniform and regular, and when unwinding the average speed must not exceed 6 inches in 10 minutes.

Stretching Test.

A 1-inch section of the rubber tube or inner lining will be cut at the lap or thickest part. Marks 2 inches apart will be placed on it. The 1-inch strip will next be stretched until the marks are 10 inches apart and then released immediately. The piece will then be remarked as at first and stretched to 10 inches, or 400 per cent., and will remain stretched 10 minutes. It will then be released, and the distance between the marks measured 10 minutes after the release. In no case must the test piece break from defective quality of rubber, or show a permanent set of more than ¼ inch between the 2-inch marks.

Small strips taken from the cover and friction will be subject to the same test.

8. If test hose fails to stand the required tests, the lot from which they are taken will be rejected without further examination. If test hose are satisfactory, the entire lot will be examined and those complying with the requirements herein set forth will be accepted.

It would seem reasonable that the developments in the manufacture and use of air hose in the next two years will warrant a further consideration of the subject at that time, and it is not unlikely that the superiority of either the tubular or wrapped form of hose will be so clearly demonstrated as to warrant a much more restricted specification; but if hose in the meantime are brought up to the standard just outlined, a marked upward step will have been taken in this important detail of car construction.

RUST FROM SALT-WATER DRIPPINGS.

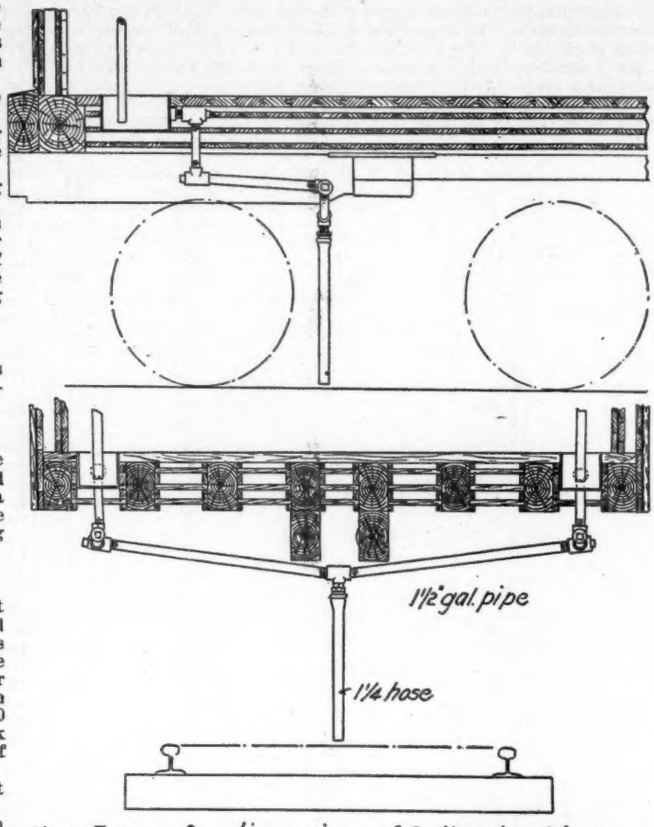
S. Higgins, A. M. Waitt—Committee.

The origin of the inquiry as to the damage resulting from salt-water drippings is clearly set forth in some remarks that were made by the chairman of the present committee during the master car builders' convention of 1897.

The fact that the Master Car Builders' Association has thought it necessary to appoint a committee to prepare a report on this subject is sufficient answer to the claims that the salt-water drippings are not harmful. The information received by the committee indicates that more interest is being taken in the subject by the officials in charge of the track and bridges than by those in charge of the rolling stock, which is accounted for by the fact that the track and the bridges are being more damaged by salt-water drippings than the car trucks.

It should be understood that the salt-water drippings come from refrigerator cars loaded with dressed beef. In such cars the mixture used for cooling purposes is composed of ice and salt, the proportion of the salt to the ice varying from 6 to 11 per cent., and one refrigerator car will produce about 200 gallons of salt water every 24 hours, which on an average will contain 8½ per cent. of salt. The committee started out with the idea of having refrigerator cars fitted with one or more reservoirs, to be attached underneath the car body, into which the salt water drippings could be conveyed, the reservoirs to be large enough so that they would not have to be emptied more than once every twelve hours, at division terminals, where the proper provision could be made for taking care of the salt water. This idea, however, met with so much opposition on the part of the refrigerator car owners that the committee abandoned it, not caring to recommend an arrangement that the refrigerator car owners would be unwilling to adopt.

The committee presents two methods that can be followed without much expense, either one of which will improve the present condition of affairs; and, although a patent has been applied for in the case of Design No. 2, it is the opinion of the committee that Design No. 2 will give the better results. Design No. 2 will be the more expensive, but will not cost to exceed $5 per car, including a royalty, if the patent is granted. The principle of both designs is to convey the salt water so that it will drop between the rails, at about the center of the track, where it will do little or no damage.



No. 1. Device for disposing of Salt Water drippings.

Dripping Device Indorsed by the Association.

In fitting up a refrigerator car with either type of attachment, care should be taken to provide caps or plugs at proper points, so that the pipes can be readily cleaned out, and galvanized iron piping should be used, in order to resist the corroding action of the salt water or brine in passing through it.

CONFERENCE WITH AUDITORS.

John S. Lentz, W. W. Atterbury, W. Garstang—Committee.

Your committee appointed to confer with a committee of the American Railway Accounting Officers' Association, with a view of recommending a plan for the simplifying of bills and accounts, met with a committee of that Association at Pittsburg, Pa., on January 27.

After a careful consideration of the subject, the following resolutions were unanimously agreed to:

1st. That all charges against any one railway company or individual car owner, as shown by the representation in the Master Car Builders' Association, must be consolidated into one monthly bill.

2d. That the standard forms for rendering of bills under the Master Car Builders' Rules shall be as follows:

Form "A"—For repairs to cars.
Form "B"—For wheel and axle work.
Form "C"—For summary of bills.

3d. That no bill shall be returned for correction on account of error for less than $1.00 in aggregate of bill, but said bill shall be passed for payment at once, and the alleged error brought to the attention of the road rendering the same within sixty days from date of bill. The receiving road shall at once issue authority for counter bill to cover the acknowledged error. If the alleged error is not conceded, the matter is to be promptly referred to the Arbitration Committee for decision.

4th. That the Executive Committee of the Master Car Builders' Association instruct the secretary to obtain from each representative member of the Master Car Builders' Association a classification of all cars the road which he represents owns or controls. That this list be printed and distributed in such manner as the Executive Committee may direct.

Your commitee does not think it advisable to submit any recommendations in regard to description of passenger equipment cars as between different railroad companies.

Your committee recommends that resolutions Nos. 1, 2 and 3 be incorporated in the M. C. B. Rules of Interchange, and the adoption by the Association of Resolution No. 4.

STEEL CAR FRAMING.

A. E. Mitchell, W. P. Appleyard, Wm. Forsyth—Committee.

The Committee on Steel Car Framing, appointed at your 1897 convention to review plans submitted by members of a similar committee in 1897, and to report upon designs for cars of different classes, has endeavored to collect the necessary information to carry out its instructions, but it has succeeded in obtaining dimensions of only one of the frames submitted in 1897 sufficiently in detail to admit of exact and complete calculations of strength. Your committee has obtained blue prints of steel car frames of several designs which were not described in the report submitted last year, but all but two of these designs lack so many dimensions that calculations of their strength could not be made, and, furthermore, attempts made by the committee to obtain further information were unsuccessful.

But twelve members of the Association replied to the circular which the committee issued to elicit information. The questions contained in the circular will be given later, as well as all answers to them which were received. The members who replied to the circular represent 151,828 cars, or about 12.4 per cent. of the total number of cars represented by the Association. The number of cars represented by those who replied to the circular and by the members of the committee is 208,389, or about 17 per cent. of the number of cars represented by the Association.

The replies received were as follows:

"If you have had any steel car frames in use, please describe all the important facts about them which your experience has brought forth, and furnish working drawings illustrating the same." Six individuals and companies reported the results of their experience with steel cars.

"Which do you consider preferable for the members of the car frames, rolled shapes of standard commercial sizes or special pressed shapes?" Six replied that they preferred rolled shapes; one preferred pressed-steel shapes except for center sills, which he thinks should be "I" beams; and one replied as follows:

"Would prefer pressed shapes for the following reasons:

"a. The various members can be made of uniform strength by placing the metal where it will be most useful.

"b. The parts can be made lighter in weight.

"c. Better connections for the various parts can be provided for."

"Which do you prefer, a car frame made entirely of steel or a composite frame made of steel and wood?" Seven replied that they preferred all steel, two preferred steel and wood, and one preferred steel and malleable iron.

"What parts do you recommend be made of wood?" One recommended that center sills only be made of steel; another replied that the end sill is the only part which it is allowable to make of wood; another recommended that the floor and the superstructure be made of wood in all cars except coal and flat; another recommended that the floor, sides and ends only be made of wood; another advised as follows: "Would recommend that any parts of car subjected to abrasion or which might be injured by the material to be carried or any covering for the purpose of protecting the load from the action of heat or cold be made of wood. Generally speaking, the covering of superstructure and floors, but not of necessity the framing of superstructure."

"What is your opinion of the advisability of using truss rods under side sills of steel car frames? and give the reasons for your opinion." The replies were as follows: Seven recommended that no truss rods be used, one recommended truss rods to support the side sills, and one recommended truss rods if by their use the car can be made lighter.

"Do you recommend that the draft gear of steel car frames be located between centre sills and firmly secured to them, or the use of independent draft timbers below the centre sills, similar to the construction which is now generally used on wooden cars?" Ten replied that the draft gear should be played between centre sills.

"Which do you recommend, wooden or steel side and end sills, and what are your reasons therefor?" Nine replied that they favored the use of steel end sills, and one recommended wooden end sills.

"Please give maximum light weight of car, per ton (net 2,000 pounds), you would recommend for each ton of paying freight?" 600, 700 and 800 pounds are recommended. One member suggested 900 pounds for coal cars only. In another reply 600 pounds is recommended for hopper cars to carry iron ore, and 800 pounds for box cars.

"Recognizing the fact that steel car framing will be used in cars of very large capacities, what type of centre plate would you recommend, and what maximum bearing pressure, per square inch, would you recommend for carrying the car and lading?" Three recommended the use of pressed steel centre plates, and one recommended malleable iron. One member recommended that the bearing pressure shall not exceed 1,600 pounds per square inch, and another 2,500 pounds per square inch. One member thought that cars should not be centre bearing, but that each of the side bearings should support as much of the load as the centre plate.

"What type of side bearing would you recommend for cars of large capacities with steel car framing?" Six recommended plain side bearings of pressed steel or malleable iron, and two recommended roller side bearings.

The members of your committee believe that at the present time it is impossible to design a steel car frame which will meet with universal favor. The extremely limited extent of the experience which has been obtained with steel cars up to date is alone a sufficient reason for recommending the postponement of the selection of a design at the present time.

CARE OF JOURNAL BOXES.

J. T. Chamberlain, J. J. Hennessey, R. H. Johnson—Committee.

Your committee, in summing up the evidence from such data as has been given it in replies to the circular of inquiry, desires to call the attention of the Convention to the fact, that considering the membership the replies were limited, and the committee feels that they are only called upon to take an account of the information given it in the replies.

A large majority recommend high grade oil for car lubrication.

But few use cooling compound, and most all consider it unnecessary in connection with car oil boxes.

That woolen waste is preferred by a substantial majority over cotton waste, and of the former, two are now experimenting with a waste of wool and foreign material, which they claim is superior to woolen.

It is the unanimous opinion that there is no material known that is a practical substitute for waste for journal-box packing, a large majority recommending woolen as the best, and your committee is of the opinion that the above majority represents the views of a majority of the members of this Convention. WASTE

The committee calls attention to the fact that two members are making tests, but are not ready at present to recommend and also to the fact that several of the members recommend woolen waste with a percentage of asbestos mixed with it as being better than woolen waste.

That a large majority recommend that waste be soaked between 24 and 48 hours before using, and at a temperature of about 65 degrees, and your committee is of the opinion that waste should be soaked at least 36 hours at a temperature of not less than 70 degrees.

That for all practical purposes the members almost unanimously recommend the common wooden dust guard so generally in usse at the present time, and your committee concurs in that recommendation. DUST GUARD

That while there is considerable difference of opinion, as indicated in the replies, existing in the minds of the members as to the best oil-box lid, all seem to desire a lid that will keep the oil from getting out of the box and the dust from getting in, the preference expressed being for the so-called Fletcher lid first, with the McCord second. LID

That the members regard the matter of careful packing as being one of utmost importance, their replies indicating that their careful attention has been given to the subject.

They are careful to have the waste soaked thoroughly at least 24 hours, packed firmly, yet not tightly, care being taken to see that the waste does not come up to the bottom line of brass (within one-half inch), and your committee fully indorses such practice. PACKING

That the members very generally consider it good practice to shake out the old and discard the worn-out short waste, mixing the good old waste after resoaking with the new, the only difference of opinion being as to when and how often it is necessary to do this. The committee is of the opinion that it is good practice, and should be done at least once a year, and the date of repacking stenciled on the truck. It further recommends it should always be done with the removal of oil boxes or change of wheels, and also in shop practice, when there is any indication that the waste has in a degree become matted or partially worn out.

In conclusion, your committee feels that it can do no better than to quote the concluding paragraph of the report of your committee of 1888 on "Journal Lubrication and the Best Practice for Economizing Oil."

"After reviewing the whole subject, your committee is of the opinion that no greater economy can be had in journal lubrication than by the use of petroleum or its products, either with or without mixtures of other oils or lubricants, along with a good elastic or spongy packing of woolen waste or material equally as good, and used in a thoroughly tight and well-constructed journal box, made especially with a view to preventing the loss of lubricant and excluding foreign particles of dust from the journal box."

SPRINGS FOR FREIGHT CAR TRUCKS.

J. S. Lentz, A. G. Steinbrenner, R. P. C. Sanderson, F. W. Brazier—Committee.

The chief aim of the committee has been to submit such designs as are practical and economical, in order that, in case of adoption, they may not become a dead letter, but serve the purpose for which they were designed. Standard springs, to be desirable, must be so designed as to best satisfy the following conditions:

1. The springs must be generally applicable to the majority of the existing cars, without expensive alterations in their application.

2. They must be so designed that they will not increase the cost of maintenance by premature failure or excessive first cost.

3. There should be a minimum number of different coils, and the different coils should be so made as to be readily distinguished one from the other, so as to prevent confusion and mistakes in application, and to reduce the cost of stock necessary to be carried for prompt repairs to both foreign and individual cars of usual design.

4. All coils used for outside bars to be wound right-handed, and the inner coils to be wound left-handed, to prevent interlocking.

In the designing of these springs, it has not been considered necessary to consider cars of less capacity than 40,000 pounds, nor does there seem to be occasion to consider a spring for pedestal trucks for cars of less than 50,000 pounds capacity, as such cars are few in number, and are not likely to be perpetual. The fact that there is no M. C. B. standard journal box for 90,000 or 100,000 pounds capacity cars debars the consideration of springs for cars over 80,000 pounds capacity for the present. These can be considered in time to come, when more of these cars are in existence, and some standard journal box is adopted. It was considered desirable that the springs and plates for use with the cars at 40,000 pounds capacity should be available for use under 50,000 and 60,000 pounds capacity cars, so that there will be no loss at such time as the 40,000 pounds cars cease to exist.

Graduated springs, or springs made of other than round bars, have not been considered, and as the elastic limit per square inch is greater for smaller bars than the larger, it is objectionable to use larger sections than are absolutely necessary. Also as spring coils, and not the spring plates, are the expensive articles and those that break, it is not desirable to sacrifice the designs of the springs for the sake of limiting the cost and number of patterns for spring plates, and it is considered preferable to buy the springs by the coil, and the plates separately, not to be put up in sets. Since it has been found upon investigation that the pressed-steel plates are slightly cheaper than malleable iron, plates of designs suitable for pressed steel only have been submitted. Moreover, the use of both pressed-steel and malleable iron plates means two separate sets of springs, as, owing to the difference in thickness of the pressed steel and malleable iron (about ¼ inch for a pair of plates), the springs used with the steel plates would have to be ¼ inch higher than those used with the malleable iron, to give the same free heights over spring plates. It has further been decided that the use of bolts for securing the top and bottom plates is not only superfluous, but a source of danger, in that these bolts get in between the coils and springs, and cause the destruction of the springs, and also a source of expense in the first cost of the spring plates, as the provision for such bolts adds to the cost.

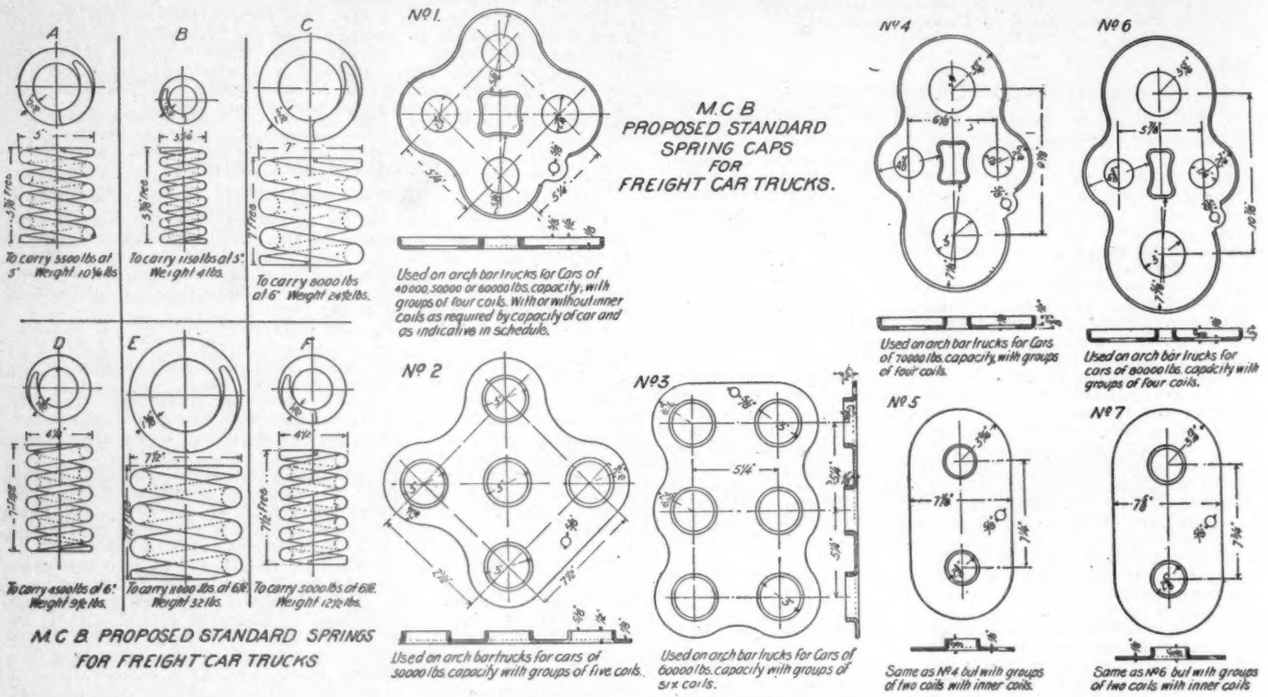
In the designing of the springs themselves, the best practice has been followed in all cases, and spring makers consulted.

Your committee therefore recommends for adoption as standards the following coils, drawings of which are submitted. The combinations in which these coils can be used appear in the schedule.

By reference to the column headed "Arch Bar Trucks," in the schedule submitted, it will be seen that the carrying capacities of the group recommended increase by fairly regular graduations. To enable the recommended standard coils to be most generally and economically useful, such groups can be selected and used as come nearest in capacity to the actual load to be carried, without reference to the marked carrying capacity of the car. Thus a heavy refrigerator car of 50,000 pounds capacity and a flat car of 70,000 pounds capacity may use the same combination of springs, on account of the great difference in light weight of the bodies.

If this plan is followed, the committee would recommend that the number and class letter of the coils to be used in each truck should be stenciled on the truck to prevent mistakes being made by repairmen.

To meet the greatest possible variety of conditions drawings for spring caps are submitted, showing caps for springs C and D or E and F, to be used in groups of four, or in groups of two, the smaller coils being placed inside the larger ones. Your committee recommends that the springs and caps submitted, and the schedule for their use, be adopted.


A
B
C
To carry 5500 lbs at 3" Weight 10¼ lbs
To carry 11 lbs of 5" Weight 4 lbs.
To carry 8000 lbs at 6" Weight 24½ lbs.
D
E
F
To carry 45 lbs of 6" Weight 9½ lbs.
To carry 1000 lbs. at 6½" Weight 32 lbs.
To carry 5000 lbs of 6½" Weight 12½ lbs.
M.C.B. PROPOSED STANDARD SPRINGS FOR FREIGHT CAR TRUCKS
No 1.
Used on arch bar trucks for Cars of 40000, 50000 or 60000 lbs. capacity, with groups of four coils. With or without inner coils as required by capacity of car and as indicative in schedule.
No 2
Used on arch bar trucks for cars of 50000 lbs. capacity with groups of five coils.
No 3
Used on arch bar trucks for Cars of 60000 lbs. capacity with groups of six coils.
M.C.B. PROPOSED STANDARD SPRING CAPS FOR FREIGHT CAR TRUCKS.
No 4
Used on arch bar trucks for Cars of 70000 lbs. capacity with groups of four coils.
No 5
Same as No 4 but with groups of two coils with inner coils.
No 6
Used on arch bar trucks for cars of 80000 lbs. capacity with groups of four coils.
No 7
Same as No 6 but with groups of two coils with inner coils.

Proposed Standard Freight Truck Springs.

SCHEDULE OF RECOMMENDED STANDARD SPRINGS.

Capacity of car.	Arch-bar trucks—per group. No of coils.	Capacity lbs.	At Inches.	Weig't lbs.	Cap.	Pedestal trucks—per box. No. of coils.	Capacity, lbs.	At Inches.	Weig't, lbs
40,000 Lbs.	4 of A	14,000	5¼	43	No. 1	.....	.....	.....	.....
50,000 Lbs.	4 of A 2 of B	16,300	5¼	51	No. 1	1 of C	8,000	6	24½
	5 of A	17,500	5¼	53¾	No. 2	.....	.....	.....	.....
60,000 Lbs.	4 of A 4 of B	18,600	5¼	59	No. 1	1 of C 1 of D	12,500	6½	34
	6 of A	21,000	5¼	64½	No. 3	.....	.....	.....	.....
70,000 Lbs.	2 of C 2 of D	25,000	6¼	68	No. 4 or No. 5	1 of E 1 of F	16,000	6½	44½
80,000 Lbs.	2 of E 2 of F	32,000	6¾	89	No 6 or No. 7	1 of E 1 of F	17,000	6¼	44½

Note.—Heights given in above include spring caps for arch-bar trucks. Number and class letter of springs used to be stenciled on the trucks of cars.

PASSENGER CAR PEDESTAL AND JOURNAL BOX FOR JOURNAL 4¼ BY 8 INCHES.

G. W. West, T. P. Purves, Jr., J. W. Marden—Committee.

Your Committee on Passenger Car Pedestal and Journal Box for Journals 4¼ by 8 inches, appointed to report to the Convention held in June, 1897, submitted a report at that time,

but certain objections were raised to the inside dimensions of the journal box as recommended. The report was referred to the Committee on Standards of the Association, which submitted the following, through Mr. Soule, chairman of the committee:

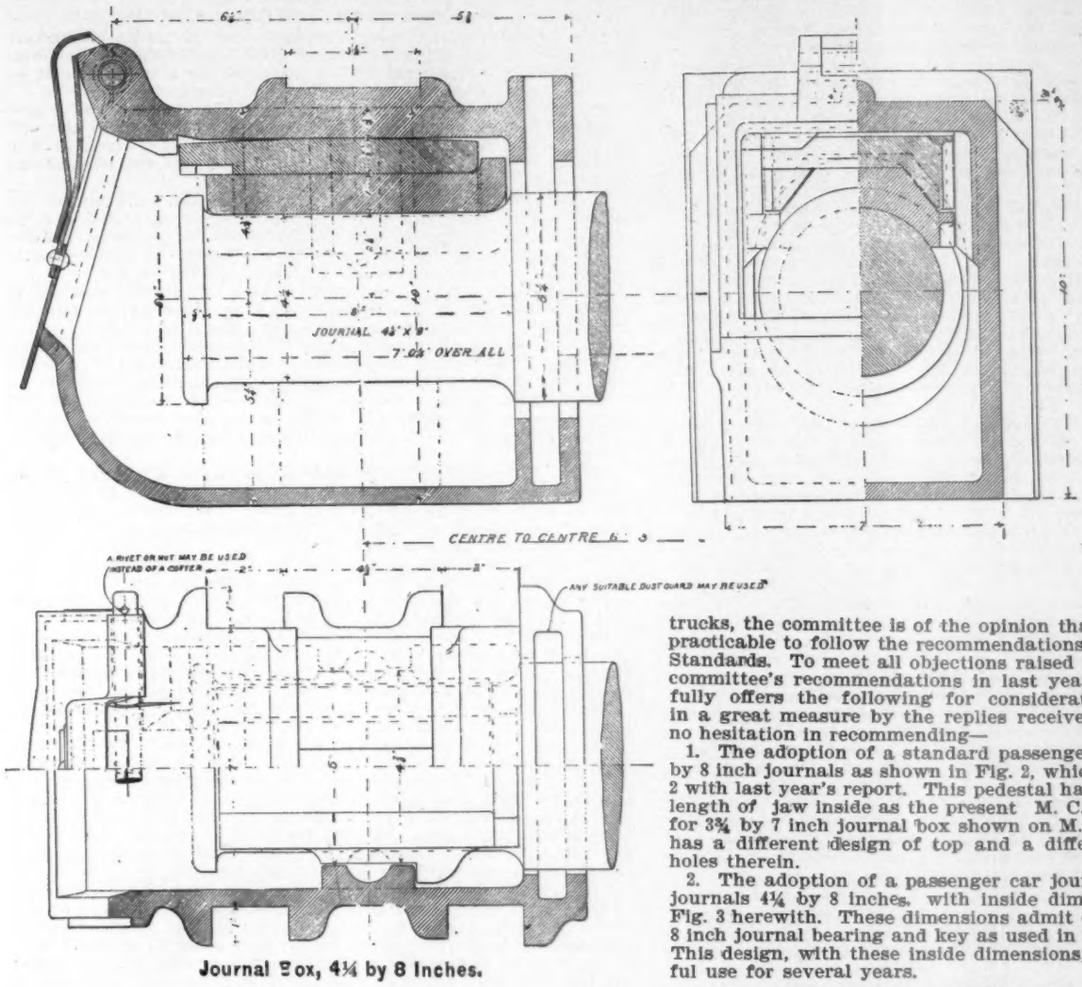
"The Committee on Standards, to which was referred the recommendation embodied in the report of the Committee on Passenger Car Pedestal, for axle with journal 4¼ by 8 inches, begs leave to report that in its judgment the Committee on Pedestals ought to be continued, and to be merged into a committee, which, it is assumed, will be appointed on the recommendation already made by the Committee on Standards, to adopt the present standard journal box for use in trucks (whether passenger or freight) having pedestals; the committee so continued to be designated, however, as the Committee on Passenger Truck Pedestal, for axle with journal 4¼ by 8 inches, and on journal box for use in trucks (whether passenger or freight) involving the use of the pedestal and axle with journal 4¼ by 8 inches."

The committee respectfully reports as follows:

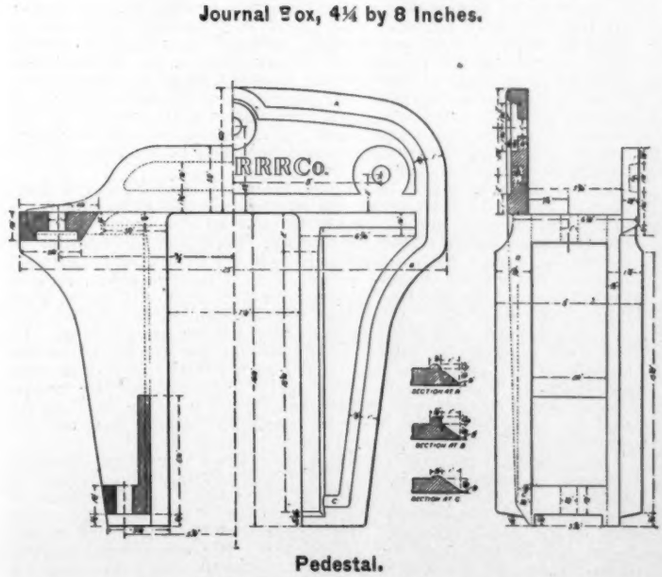
Owing to the wide variation existing between the ordinary Master Car Builders' pedestal now used in passenger equipment trucks and the various pedestals now used in freight trucks, the committee is of the opinion that it is absolutely impracticable to follow the recommendations of the Committee on Standards. To meet all objections raised to the wording of the committee's recommendations in last year's report, it respectfully offers the following for consideration; being governed in a great measure by the replies received, the committee has no hesitation in recommending—

1. The adoption of a standard passenger car pedestal for 4¼ by 8 inch journals as shown in Fig. 2, which is the same as Fig. 2 with last year's report. This pedestal has the same width and length of jaw inside as the present M. C. B. standard pedestal for 3¾ by 7 inch journal box shown on M. C. B. sheet 10, but it has a different design of top and a different location of bolt holes therein.

2. The adoption of a passenger car journal box for use with journals 4¼ by 8 inches, with inside dimensions as shown in Fig. 3 herewith. These dimensions admit of the standard 4¼ by 8 inch journal bearing and key as used in freight journal boxes. This design, with these inside dimensions, has been in successful use for several years.


JOURNAL 4½" X 8"
7'-0¾" OVER ALL
CENTRE TO CENTRE
A RIVET OR NUT MAY BE USED INSTEAD OF A COTTER
ANY SUITABLE DUST GUARD MAY BE USED

Journal Box, 4¼ by 8 Inches.



Pedestal.

THERMAL TESTS FOR CAR WHEELS.

S. P. Bush—Committee.

There were removed during a period of four years and four months on the division of the Pennsylvania Railroad from Pittsburgh to Philadelphia, a total of 7,180 wheels, on account of being either cracked or broken, 6,446 being cracked and 250 being broken. The wheels removed comprised those produced by almost every manufacturer in the United States, and it can be safely stated that practically all cast-iron wheels are subject to cracking or breaking when subjected to service with which they are likely to meet on many of the railroads of the country. A careful examination of these wheels indicated that they were cracked or broken principally by the expansion of the rim, or because of internal strains, coming as a result of imperfect manufacture, so great as to produce rupture when in service.

During the past three years it has been fully demonstrated that cast-iron wheels can be produced which will resist satisfactorily the destructive force of sudden expansion of the rim, and which will not possess, to any material extent, internal strains. This has been demonstrated by actual service, and also by means of a test designed to reproduce, in a measure, the conditions of service, now commonly known as the thermal test.

When first introduced, this test was thought to be unnecessary, and did not represent the conditions of service. The fact, however, that most manufacturers at the present time have no difficulty in producing wheels to comply with this part of the specifications, with but a small increase in cost, would rather indicate that it is quite practicable, even though it does not reproduce exactly the conditions of service. It might be stated on this particular point that the fundamental principle of all specifications relating to material has for its basis the proving of ability not to stand the usual conditions alone, but extraordinary conditions, and this, too, with a good margin to spare, commonly known as the factor of safety.

It is evident that it would not be desirable to obtain that quality in a wheel which would prevent cracking, or fracture,

at a somewhat increased cost, but which at the same time would reduce the average life materially. The opinion has been expressed by a few that if wheels are produced so as to withstand the thermal test, the wearing quality, or mileage life, will be very materially reduced. Wheels manufactured to withstand the thermal test have not been in service a sufficient length of time to demonstrate it generally, but it is thought that in another year some well-authenticated facts can be given.

Those making the above assertion endeavor to demonstrate the correctness of their position by presenting figures showing the mileage life of wheels on some roads known to have one of the qualities spoken of above, and those on other roads having the other quality spoken of to a greater extent than the former. To put this difference in quality more specifically, it might be stated that the wheel which is said to produce a greater durability of tread and flange contains a greater proportion of combined carbon, while the wheel that is best adapted to withstand the thermal test has a larger percentage of graphitic carbon.

The author then discusses the methods of stating the life of wheels, and says:

If the average of the total number of wheels in service for five consecutive years be taken, and this sum divided by five, and the yearly average of the wheels drawn for the same five consecutive years be taken, then we obtain the average life in years for the wheels drawn, which applies with considerably greater accuracy to the last one of the five years in question. Again, if we drop the figures for the first year of the group and take the figures for the succeeding year, we obtain another average life of years corresponding to the wheels withdrawn during the last year, and so on.

Of course, the total mileage life of a wheel depends directly on the depth of the chill, as well as upon the quality, but if two wheels, both having the same quality of chill, as well as the same depth, the one being made of iron of high combined carbon, known as hard iron, and the other being made of iron with low combined carbon, or the tough variety, it would certainly be expected that both wheels would give the same mileage life, so far as the chill is concerned, but that the latter would withstand the heating of the rim, or the thermal test, better than the former.

Through the General Superintendent of Motive Power of the Pennsylvania Railroad, Mr. F. D. Casanave, and the chemist of that road, Dr. C. B. Dudley, I am able to present the following facts bearing on this point:

Twenty wheels were selected from those in service, representing some of the principal makes of the country, all of which were subjected to the thermal test, 10 passing it successfully and 10 failing. Chemical analyses were made of the iron of which these 20 wheels were made, two sets of samples being taken, one from the body, or gray iron, and the other from the chill.

The main point in these analyses, to which special attention is called, is the close agreement in the composition of the chills of these different wheels. If we take the average of those that did and those that did not stand the thermal test, we find as follows:

	Total carbon.	Graphitic carbon.	Combined carbon.
Average of wheels which stood thermal test	3.81	0.42	3.39
Average of wheels which did not stand thermal test	3.73	0.42	3.31

It is difficult to see how any other conclusion can be drawn from these figures than that there is no evidence, so far as the chemical composition is concerned, to show that the chills of wheels which stand the thermal test differ in their physical properties, so far, at least, as the physical properties depend on the chemistry of the metal, from the chills of wheels which do not stand the thermal test. Also, it seems fair to conclude that wheels made in different parts of the country and by different manufacturers do not differ very widely, so far as chemical composition of the chills is concerned. It is quite obvious why this should be so, since the chill fixes the chemical composition within very narrow limits. Therefore, to emphasize what has been stated previously, it seems reasonable to conclude that the wear of wheels depends on the chill, and if chills of various wheels are as closely alike as these analyses show them to be, there is really no evidence that the wear of these chills will differ to any appreciable extent.

Referring now to the manner of conducting the thermal test. The method now used may be criticised to some extent, and justly, on the ground that it cannot be applied with absolute uniformity at all times and at all places—that is to say, in pouring the ring of molten metal around the rim of a wheel, it is difficult, if not almost impossible, to have the iron always at exactly the same temperature, so that in some cases the test will be a little more severe, and in others a little less. The test recommended by the committee last year requires that this ring of metal be poured at a temperature as low as possible without producing seams or wrinkles. It is, of course, difficult to say exactly when the iron is at such a temperature, but it is believed that the foreman in charge of most wheel foundries is so experienced as to be able to tell very closely from the appearance when the iron has arrived at this temperature before pouring. The everyday use of the present thermal test has demonstrated its extreme simplicity, and with the one exception of possible variation in the temperature of the molten metal, it seems admirably adapted to the main purpose. As to the magnitude of variation in the temperature of molten metal used for the test, it is believed that undue significance has been attached to this, and that there is a growing feeling that it is so inconsiderable as to give practical uniformity.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

Abstracts of Reports—Thirtieth Annual Convention.

BEST FORM OF FASTENING FOR LOCOMOTIVE CYLINDERS.

By R. P. C. Sanderson and T. L. Chapman, of the Committee.

The boilers, cylinders and frames should, under all conditions, be absolutely inflexible and immovable relative to one another, all necessary limberness of the machine, as a whole, must be provided for by the springs and system of equalization.

The strains that the "Cylinder Fastenings" have to resist are:

First: The direct alternating thrust of the steam in the cylinders at the frames up to, say, 38 tons, reversing itself several hundred times a minute and increased to unknown amounts by shocks due to water in the cylinders.

Second: The direct forward and backward surging of the boiler—as the back end of the boiler must be on slides or links to allow for expansion and contraction, the cylinder saddles alone must resist the tendency of the boiler to move lengthwise, due to train and coupling shocks, collisions, etc.

Third: Forward and backward sliding of the two saddles on one another, due to the cranks being at right angles and the impulses in the cylinders not occurring simultaneously.

Fourth: Wrenching strains due to the engine curving, where one side of the engine must be held back by the other, and the adhesion of the wheels on the inner rail constantly broken.

Fifth: The forward thrust on the cylinder and smoke-box bolts, due to the expansion of the boiler and resistance sometimes offered by the back boiler fastenings being defective or jammed.

Sixth: Wrenching of the saddle, due to the back end of the boiler swinging laterally on the frames; this is a very frequent defect with long boilers having heavy fire boxes, and is especialy noticeable on engines having poor back boiler fastenings when they are slipping.

The place to remedy the looseness of the cylinder saddle and smoke-box joint is at the back end of the boiler.

The weight of the boiler should be carried on two, or preferably four, long slides up to 12 inches in length and over.

The weight of the boiler should be transmitted directly from the mud ring to the top of the frame, through substantial chafing pieces on the frames, which can be easily renewed if worn; the mud ring being machined where it rests on these.

The weight of the boiler should not be carried by pads on the sides, depending on studs or rivets.

The boiler should be held down firmly to place by four side clamps, which are not depended on to hold the boiler laterally.

In addition to the lateral security afforded by bearing pieces, the boiler should be held to place laterally by strong bracing placed crosswise under the boiler at the front of the fire box, and, where practicable, across the back of the fire box where the material can be disposed of in the best direction to resist lateral movement, and tie both frames together.

Carrying the back end of the boiler on links and pins is bound to lead to trouble sooner or later. The bearing surfaces cannot be large; they will be hot all the time, and as they cannot be successfully lubricated, must be made a loose fit to start with or they seize and wring off. The smoke boxes of our heavy engines have been too often made as if they had no other duty to perform than to hold smoke, and, because they have no steam pressure to retain, are made of flimsy sheet steel, whereas the smoke box is really a part of the foundation of the whole machine. The smoke box should be made of as heavy plate as the boiler itself, and there should be a strong attachment to the boiler by means of a wide 1-inch thick ring, as well as a second ring at the front of the saddle, and bars 8 to 10 inches wide, all closely riveted to the smoke box.

One member very pithily writes: "We find that too many bolts cannot be used in securing the saddles to the smoke boxes;" but it is believed that if the back ends of the boiler are well secured, as recommended previously, fastening the saddles to the smoke boxes with a double row of 1¼ or 1⅜ inch bolts all around, spaced 4½ inches or not over 5 inches pitch, having the flanges of the saddles strengthened by ribs, will form, with honest workmanship, as secure a fastening as is needed, but not more than is really essential for heavy locomotives. All the bolts holding the saddle to the smoke box should be on the outside of the saddle in the flange, with heads inside and nuts underneath, where they can be seen. Bolts inside the saddle put up from underneath which cannot be made a driving fit, and the nuts for which must be inside the smoke box, are believed to be worth not the trouble of putting in.

Considering next the fastening of the two cylinders together, it must be remembered that the force tending to separate or slide on one another is exerted at the bottom on the plane of the centres of the two cylinders, and not at the top. To resist this to the best advantage, the strength of the fastening should be at the bottom, and not at the top. The economical trouble from loose and cracked cylinders has led to the very common use of cross-frame braces lipped over the frame bars and shrunk on, both front and back of cylinders on both upper and lower frame bars. When such braces or clamps are used, it is necessary that the frames should have a good inside bearing against the cylinder saddles so the clamps will pull the frame against the casting, and not pull against or shear the frame bolts.

Referring to the strains on the cylinders and saddles previously described in the six numbered paragraphs, it will be seen that there are some that must be wholly absorbed by the

strength of the saddle. The plain bottomless box form of saddle with cored steam and exhaust passages looks massive enough, but the metal is disposed in the weakest possible form to resist the strains referred to. Above all, there is need of plenty of metal to act as a horizontal bed plate at or near the plane of the center lines of the cylinders. We find efforts to remedy this lack by numerous clamps shrunk on in front and back of the cylinders to strain them tighter together, but here again the metal is applied at right angles to the direction of the strains. We also find horizontal plates applied front and back of the cylinders, lipped for the frames; in some instances these being bolted to flanges cast on the saddles for the purpose, and, again, others have been driven to the use of long cast-iron bumper deck plates, filling the entire space from the saddle to the front bumpers. All these are remedies for an originally bad design. There seems to be some tradition, that no one has yet broken away from, that the saddles must not be any longer than the cylinders. For instance, for a 14 by 24 inch cylinder the saddle would be about 28 inches long; for a 33 by 24 inch cylinder, the saddle would still be 28 inches long. The length of the saddle is its strength to a large extent.

Is there any reason why the saddle should not be made 6 feet

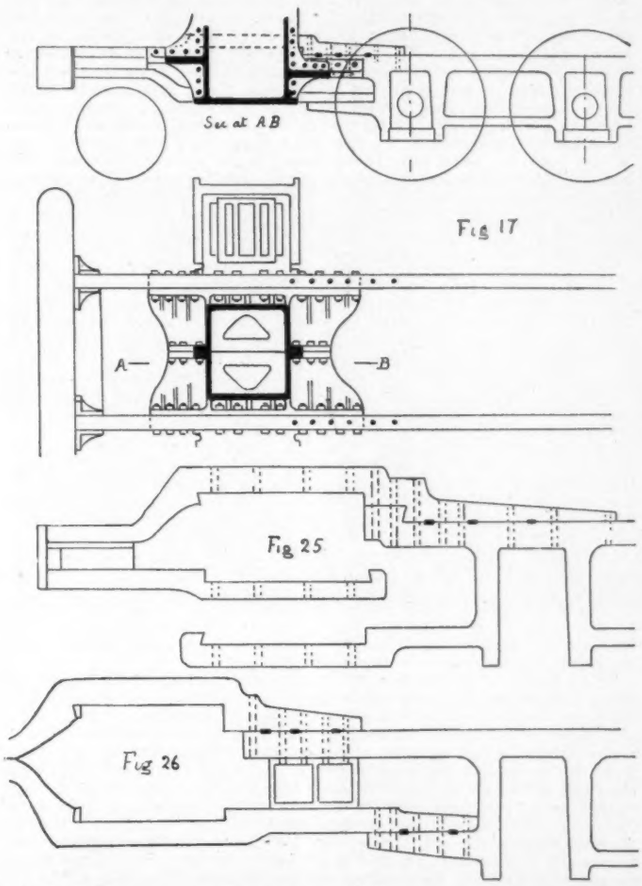


Fig 17

Fig 25

Fig 26

[The reference numbers on these diagrams are the same as given in the report.—ED.]

long between the frames, and thus furnish horizontal longitudinal stiffness which would keep the cylinders and frames square? This would do away with the necessity for clamps, plates and extra castings. But there are still formidable strains on the saddles that require additional strength in the upper part, and it is certainly good practice to rib the saddle vertically on both sides, front and back, and also use horizontal ribs.

Reverting to the argument previously made in favor of rigidity and against elasticity in the construction of the frames and attachment to the cylinders, it will be admitted that the recommendations of several prominent members to the effect that double-bar frames should be always used for heavy locomotives, even of the eight and ten wheeled types, is in the right direction, and we recommend this as good practice.

A further departure from usual practices is where the bolts holding the cylinder to the frames are put in from the bore of the cylinder. This was due to the large diameter of the cylinders and necessity of keeping the cylinder centres as close together as possible. As long as these bolts do not break or come loose the arrangement is a simple method for overcoming the difficulty; but if the head of one of them should work back and foul the piston it would likely cause a bad breakdown.

Finally, it may be predicted that a few years will see the very general use of cast steel for locomotive frames, and, as the possibilities with this metal are great, it may be that we will find both frames and cylinder saddles all cast in one piece, with the two cylinders and the upper part of the saddle made of cast iron and bolted on.

EFFICIENCY OF HIGH STEAM PRESSURE FOR LOCOMOTIVES.

W. F. M. Goss, Wm. Forsyth, Tracy Lyon—Committee.

At the time this committee was appointed, it was expected that the experimental locomotive at Purdue University would serve to give sufficient data to permit the presentation of a report dealing entirely with experimental facts. Unexpected delays have been met, and the problem has proven to be an extensive one. While more than thirty tests have been run, the full significance of the data obtained cannot be known until it is supplemented by information yet to be supplied. For this reason it has been thought best to withhold the experimental data thus far obtained until the investigations shall have developed definite conclusions. Some reference may, however, be made to the tendencies disclosed by the work already accomplished, and a general discussion of the question may be introduced.

The locomotive with which the two Stephensons competed for and won the prize at Rainhill carried a steam pressure of fifty pounds per square inch. This was seventy years ago. Since the time of the Rocket, the pressure on locomotive boilers has been gradually increasing, and to-day practice in America involves the use of pressures which fall between the limits of 140 pounds and 200 pounds. While many locomotives are running under pressures which are near the lower limit, few are now being built which are designed to carry less than 180 pounds and a pressure of 200 pounds has ceased to be uncommon. What lessons are to be derived from the experiences of the past, and to what extent are they to be relied upon to guide the practice of the future? Will the tendencies which have manifested themselves in the past continue to prevail? Are we to look for a gradual increase beyond 200 pounds, or has the maximum limit already been reached? These are the important questions which naturally suggest themselves in conncetion with the subject which is to be presented by this report.

Power and Efficiency.—The power developed by a locomotive is a measure of the work done by the steam in the cylinders; it is a function of pressure, steam distribution, diameter and travel of piston, and of speed. The efficiency of a locomotive is a measure of the degree of perfection attending the development of power; concisely stated, it is the ratio of the heat equivalent of the work done in the cylinders, to the heat supplied the fire box. The engine is most efficient which, for each pound of coal burned, develops the largest amount of power in the cylinders.

Anything which affects the efficiency either of the boiler or of the engines of a locomotive affects the efficiency of the locomotive as a whole. Boiler efficiency depends upon the proportions of the boiler and the rate of power to which it is worked, while engine efficiency depends upon many factors of which initial pressure is but one. Whatever gain in efficiency is to be derived from the use of higher steam pressure in locomotives is, therefore, to be found in the improved performance of the engine. An ideal engine will always give increased efficiency in return for increase of pressure, but the actual engine may or may not do so.

While the term "efficiency" should not be confused with "power," these terms express facts which, in a locomotive, are closely related. Under normal conditions, a locomotive is worked so near its maximum power that the limit of power is determined by the amount of coal it can burn. If improvement can be had in its process of combustion, or in the more complete absorption of heat by the heating surfaces, or by a reduction in the amount of fuel lost as sparks, the efficiency of the boiler will be increased, and at the limit of power this improvement in performance can be converted into an increase of power. Again, if the cylinders can be made to better utilize the heat supplied them, they may with a given amount of steam be made to yield greater power. It is safe, therefore, in summarizing these statements to say that anything which will operate to improve the efficiency of a locomotive may be employed as a means for increasing its power. If, therefore, increased pressure increases efficiency, it is clear that every interest will be served by its adoption.

Pressure a Single Factor Affecting Efficiency.—There can be no question but that the gradual increase of pressure which has been developing itself for many years past has been accompanied by increasing engine efficiency. It is, however, probably true that much of the improvement which has been observed is the result of betterments in mechanism, as well as of advance in the direction of pressure. This fact makes it desirable to emphasize at this point a matter to which brief reference has already been made, namely, that pressure constitutes but a single factor affecting the performance of an engine. Equally important with pressure are questions of valve proportions and of valve setting, of cylinder clearance, and of degree of expansion. Moreover, the significance of all of these factors is increased as the pressure is increased. Great improvement in efficiency, therefore, should not be expected as the result of attention given to the matter of pressure alone. On the contrary, it should be assumed that each increase of pressure is a demand for greater refinement in the mechanism of the engine. The valve action must be positive and must give a good distribution of steam at short cut-offs; the cylinder clearance must be minimum, the extent of surface bounding the clearance volume must be held to its lowest limits, and as pressures increase, compound cylinders

must be used. With such attention to details, it is probable that each increase of pressure will be found to contribute its share to the progress of the future.

There are those who view the situation to-day with the feeling that increase of pressure, being rather easily obtained, has advanced more rapidly than other measures affecting the efficiency of the locomotive. They assert that time must be had in which to perfect other details before further advances in pressure are made. If this position is true, it is likely that as in marine practice an advance in boiler pressures awaits a general adoption of the water-tube boiler, so in locomotive practice a further advance in pressure awaits the more general advent of the compound engine.

It is frequently assumed that the process of gradually increasing pressure beyond limits now common will soon reach a point beyond which it will be found impracticable to go. Difficulties in maintaining a satisfactory condition of lubrication, in using soft metal packing, and in using water glasses under pressures which much exceed 200 pounds are often cited in this connection. It would appear, however, from experience already had in marine work, that none of the difficulties are such as will block the way to the adoption of higher pressures whenever it shall be demonstrated that higher pressures are needed to further increase the efficiency of our locomotives.

High Pressure on Simple Locomotives.—The term "high pressure," as employed in this paragraph, refers to pressures above 160 pounds. The effect of such pressures on the performance of non-compound locomotives is now to be considered. The arguments for and against their adoption may be summarized as follows:

IN FAVOR OF HIGHER PRESSURES.	AGAINST HIGHER PRESSURES.
1. Smaller cylinders, and consequently lighter reciprocating parts.	1. Increased weight of boiler.
2. Reduced width of engine outside of cylinders.	2. Increased first cost of boiler.
3. Reduced first cost of engine.	3. Increased transportation charge, due to increased weight of boiler.
4. Reduced transportation charge because of reduced weight.	4. Probable increase in small heat losses, as from radiation and from leakage past valves and glands.
5. A possible gain in the efficiency of the engine, whereby a given power is developed on less steam and on less fuel than could have been done with a lower pressure.	

Reviewing the arguments as summarized above, it is to be noted that the important factor favoring the adoption of higher pressure is the possible economy which is expected to result. The other advantages are incidental, and while some of them may have great weight in particular cases, their significance in the general case merits but slight attention.

The economy which is to result from an increase of pressure must be sufficient to balance all of the considerations which in the foregoing summary appear against the adoption of such pressures. It is evident that unless the gain in efficiency is material, the net result of increasing pressure will be disappointing.

In this connection it will be profitable to review briefly the results of tests run under different pressures on the experimental locomotive of Purdue University. This locomotive carries 250 pounds pressure; its cylinders, having been constructed for special investigation, have an unusually large clearance, and at the time of the tests the valve setting gave excessive lead at very short cut-off. It is significant that these defects were sufficient in their effect to more than neutralize the gain which might otherwise have resulted from the use of higher pressures. It is, in fact, so easy to fail in securing the anticipated gain from increase of pressure, through some minor defect of design or of adjustment, as to make it probable that the most economical pressure for simple engines, in their present stage of development, is within the limits of present practice.

High Steam Pressures for Compound Locomotives.—It has already been argued that compounding is a means to the economical employment of high steam pressures, from which it follows that the maximum pressure for compounds is higher than for simple. Existing data are insufficient to serve as a basis for any prediction as to the effect of successive increments of pressure upon the efficiency of compounds of existing types.

High Pressure and Engine Dimensions.—As is well known, the volume of the cylinders of an engine which is to develop a given power is, other things being equal, inversely proportional to the available pressure. As the steam pressure is increased the size of the cylinders may be reduced. On many roads the width of engines over cylinders is already very close to the clearance width along the right of way. On such roads a demand for engines of greater power cannot be met by increasing the diameter of cylinders; hence, resort must be had either to a longer stroke of piston or to higher steam pressure. Demands of this nature will unquestionably stimulate a tendency to the employment of higher pressures, and the end will justify the means.

Boiler Pressure vs. Boiler Capacity.—It is not the purpose of this report to enter upon a general discussion of conditions affecting locomotive efficiency, but the question of boiler pressure is so closely associated with that of boiler capacity that a brief reference to the latter subject seems desirable.

The preceeding discussion discloses the fact that the proposition to improve the economy of a simple locomotive by increasing pressure beyond present limits is of doubtful value. When viewed as one of several expedients which are open for adoption, it is manifestly not of first importance. For example, within limits now common, an increase in boiler capacity offers a way to increased efficiency which is both sure and significant. If, for example, it is desirable to increase the efficiency of a locomotive now carrying 140 pounds of steam, by giving it a new boiler of the same dimension with the old, but designed for a pressure of 200 pounds, the effect produced will be entirely due to increase of pressure. The economy resulting cannot be large, and may, as in the case of experiments already cited, amount to nothing. The new boiler may weigh, approximately, 5,000 pounds more than the old. Now, it can be shown that if, instead of adding to the weight of the locomotive by making a stronger boiler, the same increase of weight had been applied to making a larger boiler, the resulting economy would not fail to be material.

In the five appendices to the report much valuable comment is made, all with a direct bearing on the subject of the report. As to the tendencies to be expected from increasing pressures, Prof. Goss says:

Two important facts are to be noted in this connection. One is that every increase of pressure results in a definite reduction in the amount of heat consumed per unit of power. It is this fact which is fundamental in any argument favoring increase of pressure. The second is that the rate of change diminishes as the scale of pressure is advanced. Thus, increasing the pressure from 25 pounds to 50 pounds reduces the heat consumption of the ideal engine 27 per cent., while an equal increment of pressure from 275 pounds to 300 pounds affects the performance of the ideal engine 2.9 per cent. It is evident from this statement of facts concerning the performance of the perfect engine, that chances for improving engine economy through increase of pressure have been greater in the past than they are likely to be in the future. Assuming the present limit to be 200 pounds, the possibility of improving efficiency through increase of pressures alone are not so great as when the limit was 100 pounds.

He sums up the use of high steam pressures in practice by showing that the general practice in marine engineering provides for a boiler pressure of about 175 pounds, with occasionally examples of higher pressures up to 200 pounds. The latter figure is considered the practicalbe limit for shell boilers of large size. Further increase of pressure depends upon the possibility of obtaining a boiler which shall be suited both to high pressures and to general marine conditions. There is a strong tendency to replace shell boilers by water-tube boilers. Especially is this true in naval work, where weight is an important factor, and in yachts of high speed. Where water-tube boilers are used, they commonly carry a pressure of from 250 to 300 pounds, but for the general conditions of trans-ocean traffic the water-tube boiler, in its present forms, has not yet commanded sufficient confidence to insure it a definite standing in this field. It is significant that while marine engineers are generally alive to the advantages to be derived from high pressures, they have not seen their way clear to utilize pressures which exceed those now common in locomotive service.

In regard to the influence of higher boiler pressures upon the cost of maintenance, Mr. Tracy Lyon, member of the committee, concludes as follows:

It is evident that the available data are too meagre to admit of any positive conclusions, but it seems the more probable that the use of high steam pressures need not be attended by any considerable increase in the cost of repairs.

The results of the elaborate tests conducted by the committee were disappointing, and while they were entirely consistent one with another, they were very unexpected, and the new locomotive now in use upon the testing plant at Purdue University did not show as good results, economically considered, as the former one designed for a pressure of only 140 pounds. This was thought to result from differences in cylinder design, and as the cylinders of the present locomotive (See American Engineer January, 1898, page 7) are fitted with bushings in order to permit of experimenting, with various different cylinder ratios, the clearance was excessive and was nearly 50 per cent. more than in usual practice. The valve setting was also unfavorable to good results with high pressures, and the results constitute a better study in cylinder clearance than in the use of high pressures. A discussion of the relative importance of Pressure vs. Capacity of locomotive boilers is given in the fifth appendix, by Mr. Wm. Forsyth, and it is so well considered, so logical and timely, that we shall print it in full in our next issue.

BEST METHODS OF BOILER AND CYLINDER INSULATION.

J. H. Manning, J. F. Deems, Wm, McIntosh—Committee.

The circular and replies were as follows:

1. Do you use any kind of insulating covers for your boilers, other than wood? To this twenty-eight railroads, representing 10,098 locomotives, replied in the affirmative; five, representing 582 locomotives, replied that they used wood only; one railroad, representing 649 locomotives, stated they used wood covering principally, but were trying a few other kinds to find the relative value.

2. If so, what has been your experience, compared with wood lagging, from an economical standpoint? To this five replied they had no experience, seven did not venture an opinion, account of limited experience, twenty-two replied it was more economical than wood.

3. If you have made any tests, please give committee the results, setting forth the manner of arriving at same? To this all replied they had made no special tests.

4. Give cost per square foot applied, and kind of lagging re-

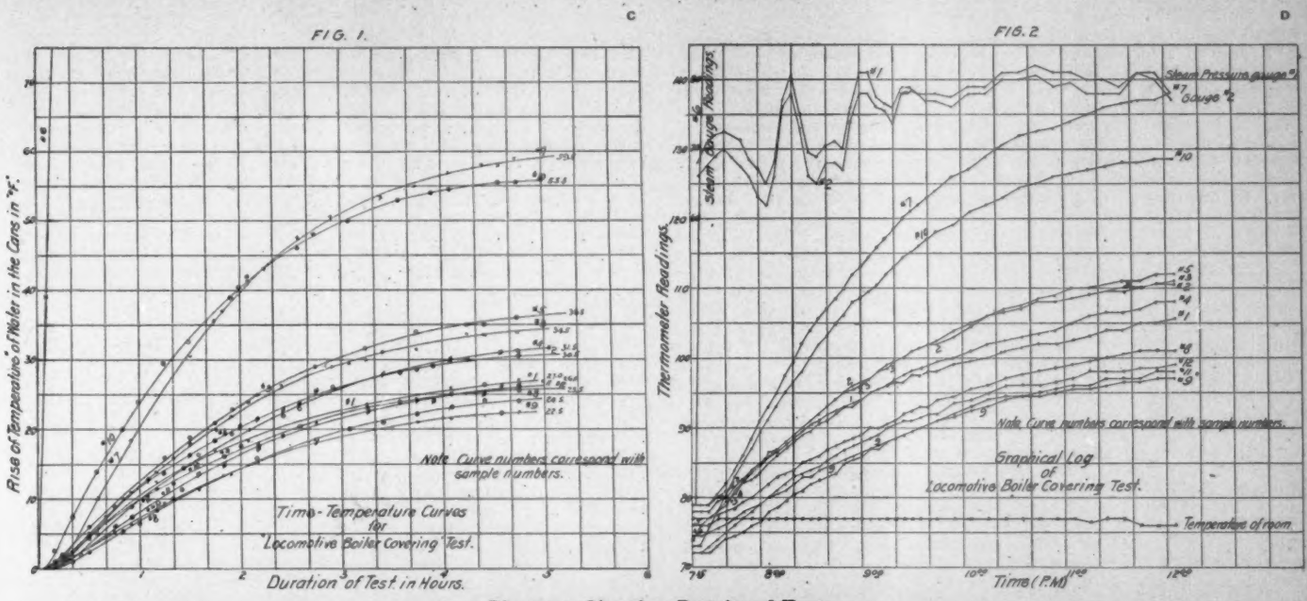
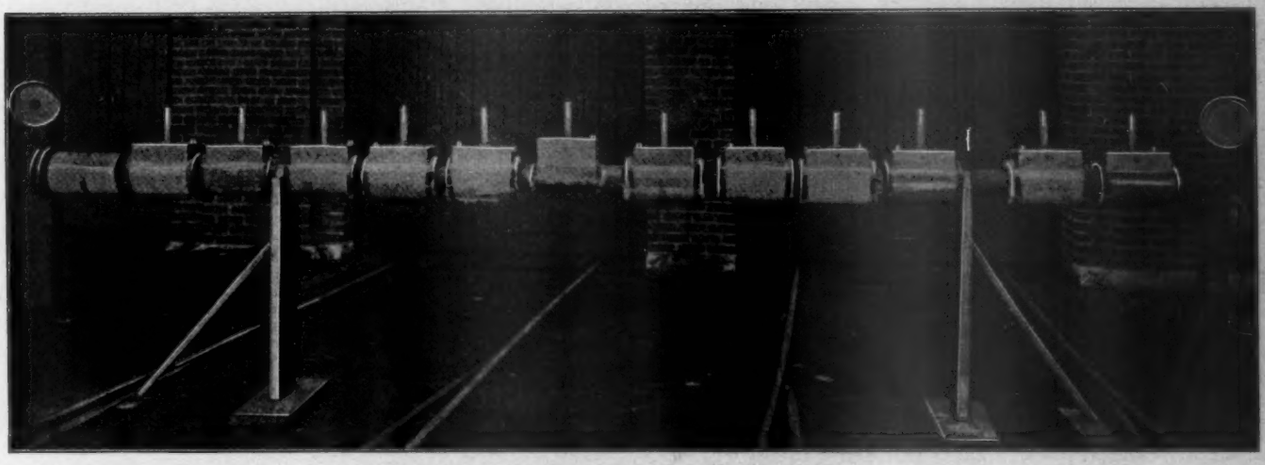


FIG. 1.
Rise of Temperature of Water in the Cans in °F.
Duration of Test in Hours.
Note. Curve numbers correspond with sample numbers.
Time-Temperature Curves for Locomotive Boiler Covering Test.
FIG. 2
Thermometer Readings.
Steam Gauge Readings.
Steam Pressure gauge #1
#7 Gauge #2
Note. Curve numbers correspond with sample numbers.
Graphical Log of Locomotive Boiler Covering Test.
Temperature of room.
Time (P.M.)

Diagrams Showing Results of Tests.



Experimental Apparatus Used in Making Comparison.

ferred to; the latter for information of your committee only? There were twenty replies to this; nine showing lagging costs from 21 to 29 cents per square foot applied, eleven stating that it cost from 7 to 18.6 cents per square foot, according to thickness. Two roads replied that they lagged both sides and heads of boilers; four that they lagged the sides only; three that they lagged the heads of certain engines, with large boiler heads account of excessive heat in the cabs. Nineteen replied that they had no experience whatever in lagging cylinders and steam chests. Of the fifteen that had some experience, six used wood, one filled all spaces around casings and coverings with hair felt, eight used different kinds of insulation.

Samples were furnished by the manufacturers, with the exception of the wood, and in addition to these samples the committee took from store stock additional samples of each kind, which were tested along with those furnished by the manufacturers. The reason for this is obvious.

No. 1. This sample contained:

Asbestos	7.19 per cent.
Lime (calcium oxide)	31.64 "
Sulphur tri-oxide	48.70 "
Loss by ignition	9.00 "

No. 2. Pine wood.

Nos. 3, 4 and 5. These samples contained:

	3 and 5.	4.
Asbestos	68.33;	64.84 per cent.
Oxide of magnesia	16.75;	22.70 "
Loss by ignition	14.90;	13.00 "

No. 6. The bare pipe.

No. 7. This contained:

Asbestos	43 97 per cent.
Lime	51.28 "
Rope	1.83 "
Sawdust	2.92

Nos. 8 and 9 contained as follows:

Asbestos	4.0 per cent.
Carbonate of magnesia	95.3 "

No. 10 contained as follows:

Asbestos	46.6 per cent.
Alumina and iron oxides	11.0 "
Magnesia oxide	25.5 "
Loss on ignition	14.3 "

Nos. 11 and 12.

No. 11 contains as follows:

Asbestos and silica	31.60 per cent.
Oxide iron	2.00 "
Oxide aluminum	15.30 "
Oxide calcium (lime)	53.10 "
Oxide magnesia	3.50 "
Sulphur tri-oxide	7.58 "

Samples Nos. 5, 8 and 11, being received in sheet form, were fitted to the pipe; the others were received in cylindrical form to fit a 4-inch pipe. The samples, which were each twelve inches in length, were placed on the pipe with a space of two inches separating them; the ends and joints on each sample were sealed up to avoid the possibility of air circulation in the interior of the samples. On each sample was placed a reservoir made of tin, 5⅜ by 10 inches in size, with concave bottom to fit the sample, each having an exposed radiating surface of about 136½ square inches and containing 3½ pounds of water. The thermometers used were carefully calibrated and compared. A steam gauge which had been compared with a standard test gauge was placed on each end of the pipe. The thermometers were inserted at the centers of the reservoirs to an equal depth into the water, after which the reservoirs were sealed tight. The reservoir marked No. 6, which was placed on the bare pipe, exposed about 220.7 inches of radiating surface, and contained 7½ pounds of water. For this reason, and the fact that the water in this reservoir boiled so soon after steam was turned into the pipe, the time temperature curve is incorrect; this could, however, be omitted without detracting in any way from the value of the tests.

A steam connection was made at one end of the pipe, and a drain provided at the other, the latter being kept slightly open during the test. Observations began at 7.15 p. m. and were taken every five minutes up to 9.40 p. m., and from that time up to the close of the test every ten minutes, the result of which is clearly shown in Figs. 1 and 2, the former showing clearly the rise in temperature of the water in the reservoirs; the latter the temperature readings every five and ten minutes, as stated. Mr. T. Lyon, Master Mechanic of the Chicago Great Western

Railway, in answer to the committee's inquiry, gives some interesting figures, based on the result of a test conducted by him some time ago, as follows:

"Prepared two lengths of 2-inch iron pipe, each six feet long and connected with a boiler, by covering one of them with wooden lagging and a russia iron jacket, and the other with mineral covering about one inch thick and a similar russia iron jacket. These pipes were placed on an angle so that the water of condensation would drain toward one end, where there was a small cock, and both ends, as well as the steam pipes leading to them, were well covered by being wrapped with hair felt. Steam was turned on and the water of condensation drawn from each pipe and weighed at intervals of one hour, the amount of water being considered as a measure of the relative efficiency of the covering as non-conductors of heat.

"With an average steam pressure of 76 pounds (absolute) in the steam pipe and an average temperature in the room of 56 degrees, the mean loss from the pipe lagged by wood was three pounds of steam per hour, and that from the pipe lagged with mineral, nine-tenths pound per hour, corresponding to a loss of heat of 448 B. T. U. and 139 B. T. U. per lineal foot per hour respectively. This would indicate that the mineral lagging is almost three times as effective as the wooden lagging."

He goes on to state that the loss of heat would be about 0.34 B. T. U. per square foot on radiating surface per degree of difference in temperature of the steam and the outside air, using mineral lagging, and 1.10 B. T. U. using wooden lagging, showing a difference in favor of the former of 0.76 B. T. U., and gives the following example:

"Taking a boiler with 300 square feet of radiating surface, carrying 160 pounds of steam and a mean outside temperature of 50 degrees Fahr., the difference in the loss would amount to 830 pounds of water in ten hours, representing, say, 166 pounds of coal, or, at $1.50 a ton, 12½ cents' worth. This should represent approximately the saving in coal by the use of a lagging such as tested instead of a wooden lagging under average conditions, and, if these figures are correct, the mineral lagging would about pay for itself in a year. These experiments were made in still air; the conditions in service on a locomotive being still more favorable for further economy."

We found it impossible to collect any reliable data based on actual and practical results, as to fuel economy, as the variables entering into a test of this nature are so great; hence, it was not considered advisable to undertake it.

Your committee is decidedly of the opinion, notwithstanding the absence of this latter information, that economical results will follow the use of good non-conducting material, carefully applied to the boilers, cylinders, steam chests, steam passages and all radiating surfaces where conditions are such that the estimated economy will not be overcome by the inconvenience and expense of removing same for repairs.

THE APPRENTICE BOY.

W. F. Bradley, W. H. Harrison, G. R. Joughins, A. E. Manchester, H. P. Robinson—Committee.

Your committee has drawn up a code of rules, which it believes to be sufficiently broad to be generally acceptable. Your committee also believes that the general adoption even of those elementary rules will be of great benefit, and that they will serve as a foundation on which a complete system, uniform in its details, can ultimately be built. We recommend the adoption of the code of rules as given below, to be known as "The Standard Code of Apprenticeship Rules of the American Railway Master Mechanics' Association." We also recommend the adoption of certain resolutions of instructions which will enable this committee to assist in getting the rules generally adopted.

Apprenticeship Rules.

1. A regular apprentice is one who has had no previous shop experience and is not a graduate of a technical institution.
2. No regular apprentice shall be taken into the shop below the age of fifteen or after the age of nineteen years.
3. No apprentice shall be taken into the shop who has not received the elements of a common education, and who does not give evidence of such capacity as to promise the ability to become a competent mechanic.
4. No apprentice shall be taken into the shop without the consent of his parents or lawful guardians, who shall have a thorough understanding of the conditions of such apprenticeship, and who shall execute such documents, including a release of the company from liability for accidents to the said apprentice, as the company may require.
5. The term during which an apprentice shall serve before receiving a certificate of apprenticeship shall not be less than three years nor more than five years.
6. There shall be a regular apprentice course framed for each shop, which course each apprentice shall go through during his term, the time to be spent on each class of work being defined, and such definition shall be observed as closely as practicable with due regard to the capacities and condition of the individual apprentice.
7. During the term of the apprenticeship a careful and proper record shall be kept of the work in progress of the apprentice, and also of the general behavior and conduct, which record shall be entered on properly authorized blanks or books provided for the purpose not less frequently than once every week during such term.
8. Each apprentice shall be paid for the work done by him upon a scale duly agreed on and provided for in advance.
9. Under no circumstances shall the company assume any liability for the employment of an apprentice after the conclusion of his term.
10. On the conclusion of the term of apprenticeship, each apprentice shall be given a certificate in a proper form, duly signed by the proper officer of the company, which shall set forth the length of time which each apprentice has served and the work on which he has been engaged, as well as some indication of his general behavior during his term.
11. Apprentices who have already served part of a term in other shops, or who have taken part of a course at a recognized technical institution, may be received under such modifications of the foregoing rules as may be deemed proper.

Under the heading of recommendation the committee suggests four years as the proper length of course, and believes that a boy who does not complete the course in five years had better be something else than a mechanic. The following plan is recommended:

Machine Shop.

Tool Room.—General use of tools, names, etc., work on small planer, drilling machine, shaper and lathes, provide tools; six months to actually serve.

Erecting Shop.—Helping on general work—gang No. 1, one month; helping on general work—gang No. 2, one month; helping on general work—gang No. 3, one month.

Machine Shop.—General instructions, milling machine, boring mill, horizontal machine, axle lathe, and helping in general; three months to actually serve. Boring, driving and truck brasses, and quartering machine; two months. Cylinder boring machine and planer; one month. Rod: Rod gang, three months; small lathe (alone), two months; large slotter, one month; brass lathe, two months; small planer, one month; large and small planers, two months; driving wheel lathe, one month; large lathe (alone), two months; motion work lathe, one month; general vise work, three months; surface table, three months.

Erecting Shop.—General work—gang No. 1, five months; general work—gang No. 2, three months; general work—gang No. 3, four months.

Blacksmith Shop.

1. To start the apprentice on a bolt machine for six months. Here he will learn the rudiments of heating iron; also the setting and adjusting of dies, and at the same time by observation will learn the names of the tools and their use in that portion of the shop. 2. The next six months in operating a steam hammer. In this position he has a good opportunity to note how the blacksmiths handle and form iron; at the same time require him to help at the fires in the immediate vicinity of the hammer. 3. The next six months he should be as a helper on a small fire, with a man who is quick and handy with light work. 4. The next six months on a light fire without a helper, where he will learn to handle the hand hammer. 5. For the next three months give him a light fire with a helper; the fire should be so located that he will be called on to assist in taking heats for the larger fires. 6. For the next six months on heavier work that does not require skill. 7. For the next three months helping at the tool-dressing fire, and if the shop has two tool-dressing fires, the next three months on the second tool-dressing fire. 8. The next twelve months put him on a heavy fire with as much of a variety of work as can be arranged.

Boiler Shop.

1. The first three months heating light rivets. 2. The next three months helping on the heavy sheet-iron work, such as wheel covers, ash pans, etc. 3. Three months holding on rivets for tank work. 4. Three months holding on rivets for boiler work. 5. Six months riveting on patches, chipping and calking on tank work. 6. Six months setting flues. 7. Six months patching and bracing boilers, chipping and calking and general riveting. 8. Six months blacksmithing, to learn how to make and fit braces, to dress necessary tools and assist in fitting up his work. 9. The fourth year to lay out flange and do general boiler work.

Foreman of Apprentices.

It is recommended that some one person be given direct charge of all apprentices and be held responsible for their proper instruction. He can be known as "the Foreman of Apprentices," or he can be designed to perform the duties, without special title, in conjunction with his ordinary work.

The scale of pay must be governed largely by geographical and individual conditions. It is recommended that the rate of pay be 50 cents for a ten-hour day for the first year, with an increase of 25 cents a day for each year thereafter. For an eight-hour day 40 cents a day at the start and 20 cents a day increase yearly.

It is desirable that apprentices should be given the opportunity of acquiring general knowledge of the departments of railways in addition to the work inside the shops. This must be largely a matter for the judgment of the officers of individual companies, but valuable talents may be discovered by giving a boy a chance to get some acquaintance with the drafting room, with signal work, with transportation and operating methods. At the worst, such an acquaintance will not make a mechanic a poorer workman.

It is very desirable that apprentices should receive some instruction of a scholastic nature outside the shops during their term. This, again, is largely a matter of individual judgment, in accordance with the size of the shop and the facilities in the neighborhood for the furnishing of such instruction.